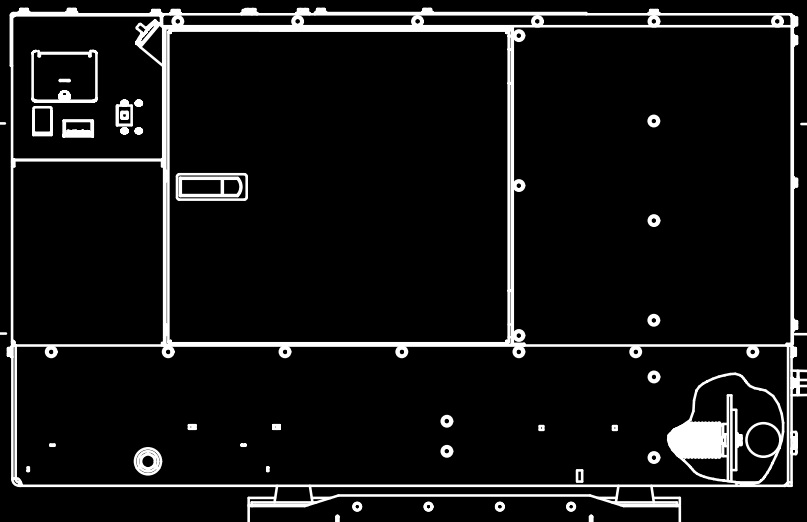


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Onan *Mobile GenSet*

Service Manual

HDCAA, HDCAB, HDCAC, HDCAD



California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.



WARNING



**Do not use this genset on a boat
Such use may violate U. S. Coast Guard
regulations and can result in
severe personal injury or death from
fire, electrocution, or
carbon monoxide poisoning**

Supplement: 981-1049

Date: 09/04

Insert with-

Manual Number (Date):	981-0173 (08/04)	981-0174 (08/04)	981-0540 (08/04)
	981-0170 (11/03)	981-0171 (11/03)	981-0526D (02/04)
	981-0166B (06/03)	981-0167B (06/03)	981-0535 (10/02)
	981-0161 (08/89)	981-0522B (07/99)	

Purpose: These instructions supplement the instructions for filling the engine cooling system found in the *Periodic Maintenance* sections of the Operator's and Service Manuals listed above.

⚠WARNING *To prevent severe burns from hot coolant under pressure, carefully observe all of the Safety Precautions and Instructions in the Manual for handling and filling coolant.*

Instructions: Use a funnel when filling the cooling system through the fill opening (Figure 1) to prevent coolant from entering the vent hose and blocking the escape of air as the system fills. The system *will seem full when it actually is not* if the air cannot escape through the vent hose. If the vent hose does get blocked, pinch the overflow hose and blow the vent hose clear.

⚠CAUTION *Coolant trapped in the vent hose will prevent the system from filling to its capacity, which can lead to serious engine damage.*

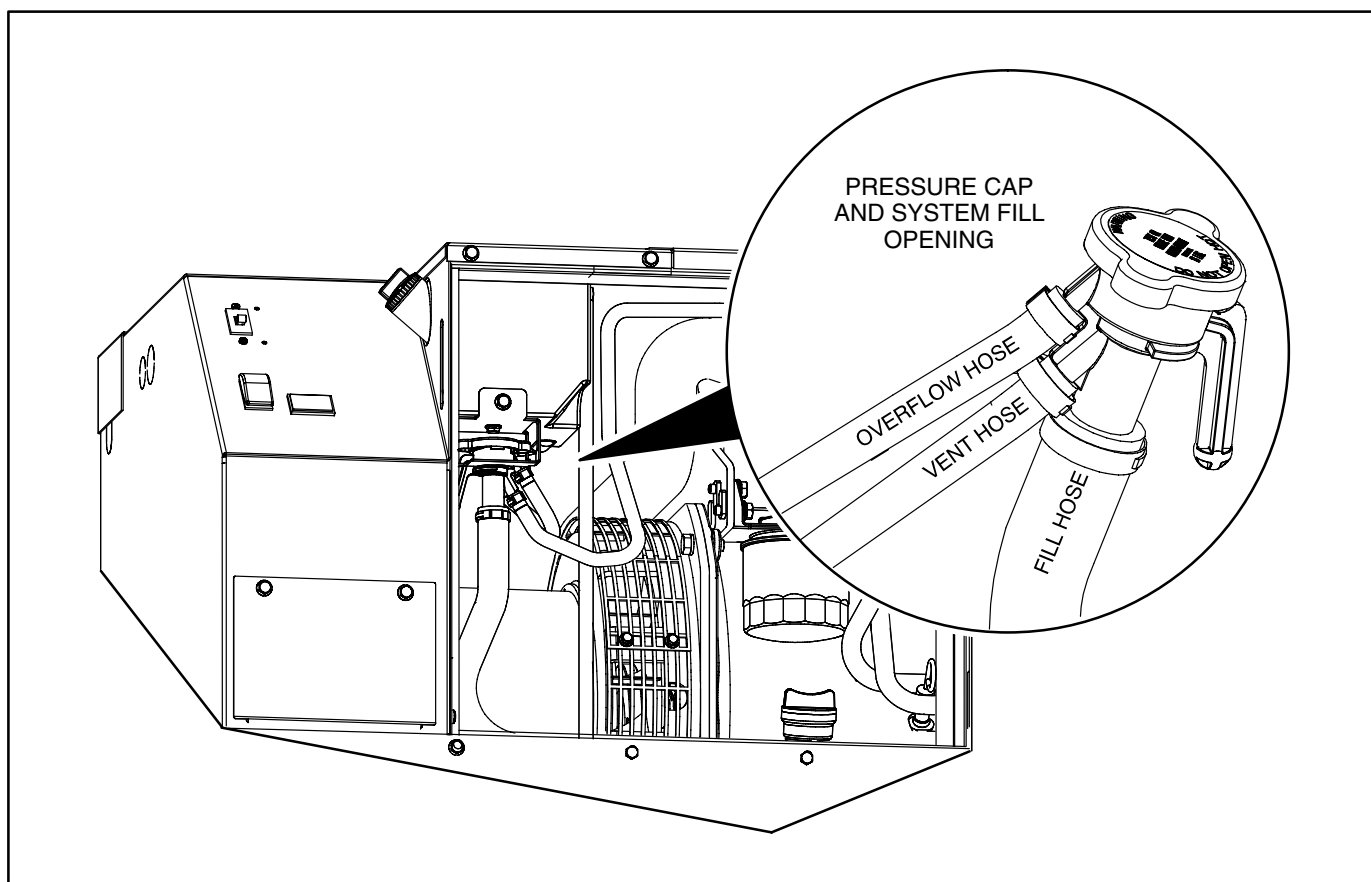


FIGURE 1. TYPICAL COOLANT FILL OPENING WITH CONNECTED FILL, OVERFLOW AND VENT HOSES

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Safety Precautions

Thoroughly read the **OPERATOR'S MANUAL** before operating the genset. Safe operation and top performance can only be obtained when equipment is operated and maintained properly.

The following symbols in this manual alert you to potential hazards to the operator, service person and equipment.

⚠ DANGER alerts you to an immediate hazard that will result in severe personal injury or death.

⚠ WARNING alerts you to a hazard or unsafe practice that can result in severe personal injury or death.

⚠ CAUTION alerts you to a hazard or unsafe practice that can result in personal injury or equipment damage.

Electricity, fuel, exhaust, moving parts and batteries present hazards which can result in severe personal injury or death.

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (–) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Make sure all fasteners are secure and torqued properly.

- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- You must be trained and experienced to make adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Disable the automatic genset starting feature of an inverter-charger or other automatic starting device before servicing the genset.
- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Back-feed could lead to electrocution of utility personnel and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Learn the symptoms of carbon monoxide poisoning in this manual.
- Never sleep in the vehicle while the genset is running unless the vehicle is equipped with a working carbon monoxide detector.
- Make sure there is ample fresh air when operating the genset in a confined area.
- Disable the automatic genset starting feature of an inverter-charger or other automatic starting device before storing the vehicle or parking it in a garage or other confined space.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- Engine cooling air must not be used for heating working or living spaces or compartments.

DIESEL FUEL IS COMBUSTIBLE

- Do not smoke or turn electrical switches ON or OFF where fuel fumes are present or in areas sharing ventilation with fuel tanks or equipment. Keep flames, sparks, pilot lights, arc-producing equipment and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses.
- Do not smoke.
- To reduce arcing when disconnecting or reconnecting battery cables, always disconnect the negative (–) battery cable first and reconnect it last.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Disable the automatic genset starting feature of an inverter-charger or other automatic starting device before servicing the genset.
- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, and other moving parts.

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc.*** The owners and operators of the genset are solely responsible for operating the genset safely.

1. Introduction

ABOUT THIS MANUAL

This is the service manual for the generator sets (gensets) listed on the front cover. Read and carefully observe all of the instructions and precautions in this manual.

⚠ WARNING *This genset is not a life support system. It can stop without warning. Children, persons with physical or mental limitations, and pets could suffer personal injury or death. A personal attendant, redundant power or an alarm system must be used if genset operation is critical.*

⚠ WARNING *Improper service or replacement of parts can lead to severe personal injury or death and to damage to equipment and property. Service personnel must be qualified to perform electrical and mechanical service.*

⚠ WARNING *Unauthorized modifications or replacement of fuel, exhaust, air intake or speed control system components that affect engine emissions are prohibited by law in the State of California.*

See the Installation Manual for important recommendations concerning the installation and for a list of the installation codes and standards for safety which may be applicable.

See the Parts Manual for part identification numbers and required quantities. Genuine Onan® replacement parts are recommended for best results.

When contacting Onan for parts and product information, be ready to provide the model and serial numbers on the genset nameplate. Figure 1-1 illustrates the nameplate and its location. The numbers in the gray boxes are typical model and serial numbers. Every character in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.)

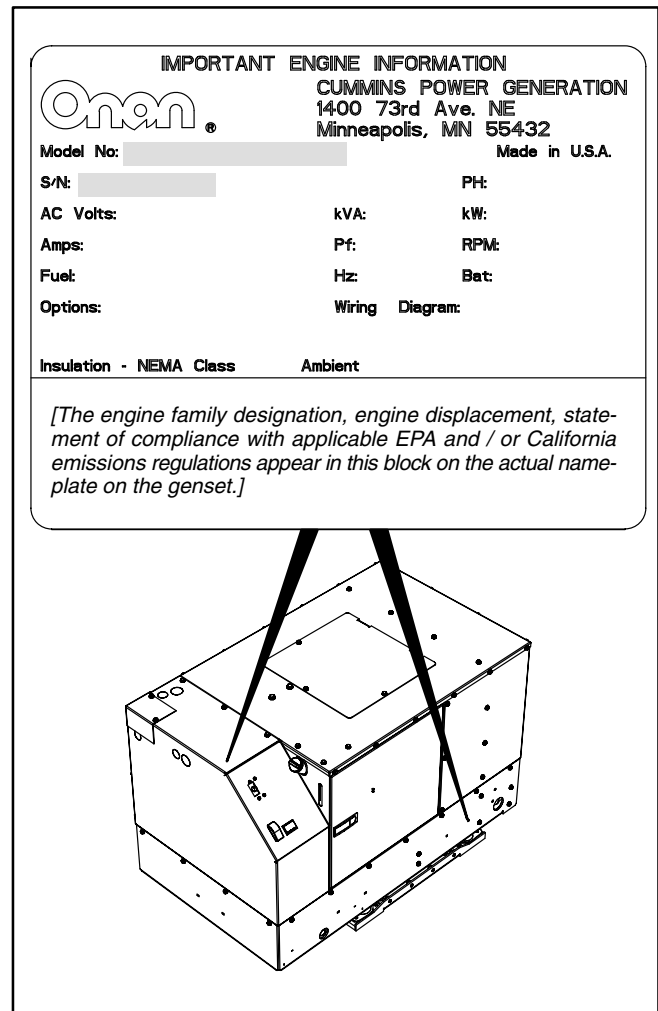


FIGURE 1-1. TYPICAL NAMEPLATE

FUEL RECOMMENDATIONS

⚠ WARNING *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.*

Use clean, fresh No. 2 diesel fuel (ASTM 2-D) when the outdoor ambient temperature is above freezing, and No. 1 diesel fuel (ASTM 1-D) when below freezing. The fuel should have a Cetane number of at least 45 for reliable starting.

ENGINE OIL RECOMMENDATIONS

Use API (American Petroleum Institute) performance Class **CH-4** engine oil or better. Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 1-2, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

STARTING BATTERIES

The genset requires a 12 volt battery to power its control and starting circuits. Reliable genset starting and starter service life depend upon adequate battery system capacity and maintenance. See **MAINTAINING THE BATTERY AND BATTERY CONNECTIONS** (p. 3-5) and *Section 14. Specifications*.

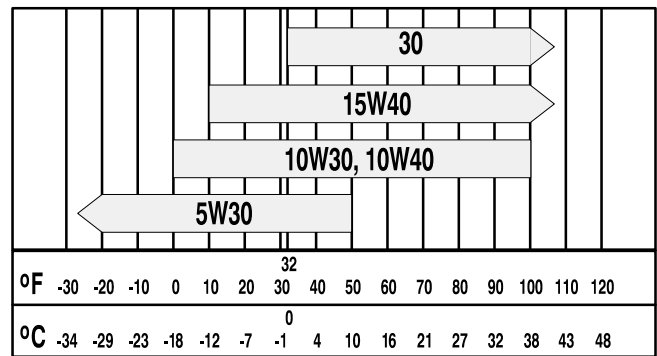


FIGURE 1-2. OIL VISCOSITY VS. TEMPERATURE

2. Operation

CONTROL PANEL (BEGINNING SPEC C)

The control panel (Figure 2-1) has the following features:

Control Switch – This switch is used to start and stop the genset, prime the engine fuel system and restore the fault code (blinking status light).

Status Light – This is an LED (light emitting diode) in the control switch which blinks rapidly during pre-heat and cranking. After the genset starts up, this light stays on continuously, indicating that the genset is running and that the starter has disconnected. If the genset shuts down, this light blinks a numerical code to indicate the nature of the fault shutdown (see *Section 12. Troubleshooting*).

(Rapid blinking before cranking starts indicates that the glow plugs are preheating the combustion chambers. The controller automatically varies the time based on engine temperature.)

Line Circuit Breaker(s) – The line circuit breakers protect the AC power leads connected to the genset.

Coolant Recovery Tank Fill Cap – The recovery tank provides for coolant expansion. Replenish the normal loss of coolant by filling here.

Hour Meter – The hour meter records the total running time of the genset. It cannot be reset.

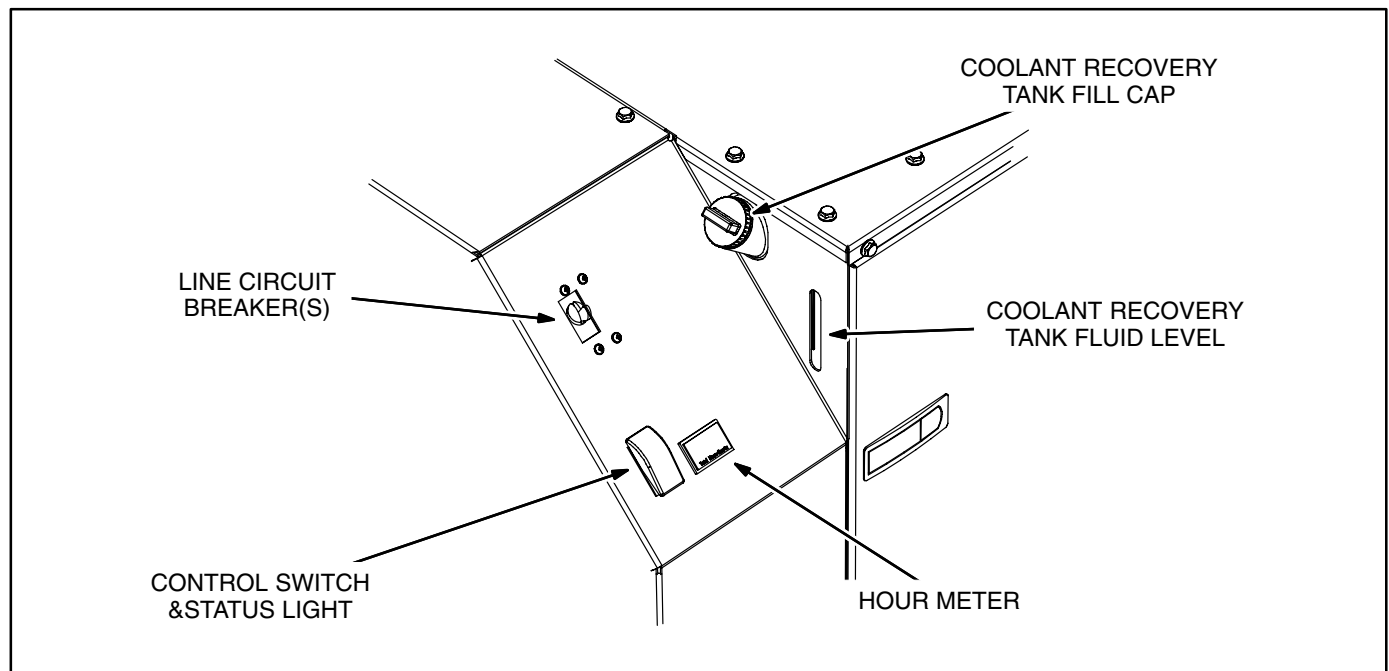


FIGURE 2-1. CONTROL PANEL (BEGINNING SPEC C)

CONTROL PANEL (PRIOR TO SPEC C)

The control panel (Figure 2-2) has the following features:

Control Switch – This switch is used to start and stop the genset, prime the engine fuel system and restore the blinking fault code.

Status Light – This is an LED (light emitting diode) in the control switch which blinks rapidly during pre-heat and cranking. After the genset starts up, this light stays on continuously, indicating that the genset is running and that the starter has disconnected. If the genset shuts down, this light blinks a numerical code to indicate the nature of the fault shutdown (see *Section 12. Troubleshooting*).

(Rapid blinking before cranking starts indicates that the glow plugs are preheating the combustion chambers. The controller automatically varies the time based on engine temperature.)

Line Circuit Breaker(s) – The line circuit breaker(s) protect the AC power leads connected to the genset.

Coolant Recovery Tank Fill Cap – The recovery tank provides for coolant expansion. Replenish the normal loss of coolant by filling here.

Coolant Pressure Cap – The coolant pressure cap is accessible by removing the access plate on the control console. Fill coolant here when refilling the system.

Fuses F1 and F2 – These fuses are accessible by removing the access plate on the control panel. They protect the control circuits of the genset.

Hour Meter – The hour meter records the total running time of the genset. It cannot be reset.

REMOTE CONTROL

The vehicle is probably equipped with a remote control panel having a **Control Switch**, **Status Light** and **Hour Meter**. For models prior to Spec C the panel may also have the following engine gauges:

Oil Pressure Gauge – The oil pressure gauge indicates engine oil pressure.

Water Temperature Gauge – The water temperature gauge indicates engine coolant temperature.

Voltmeter – The voltmeter indicates DC system voltage.

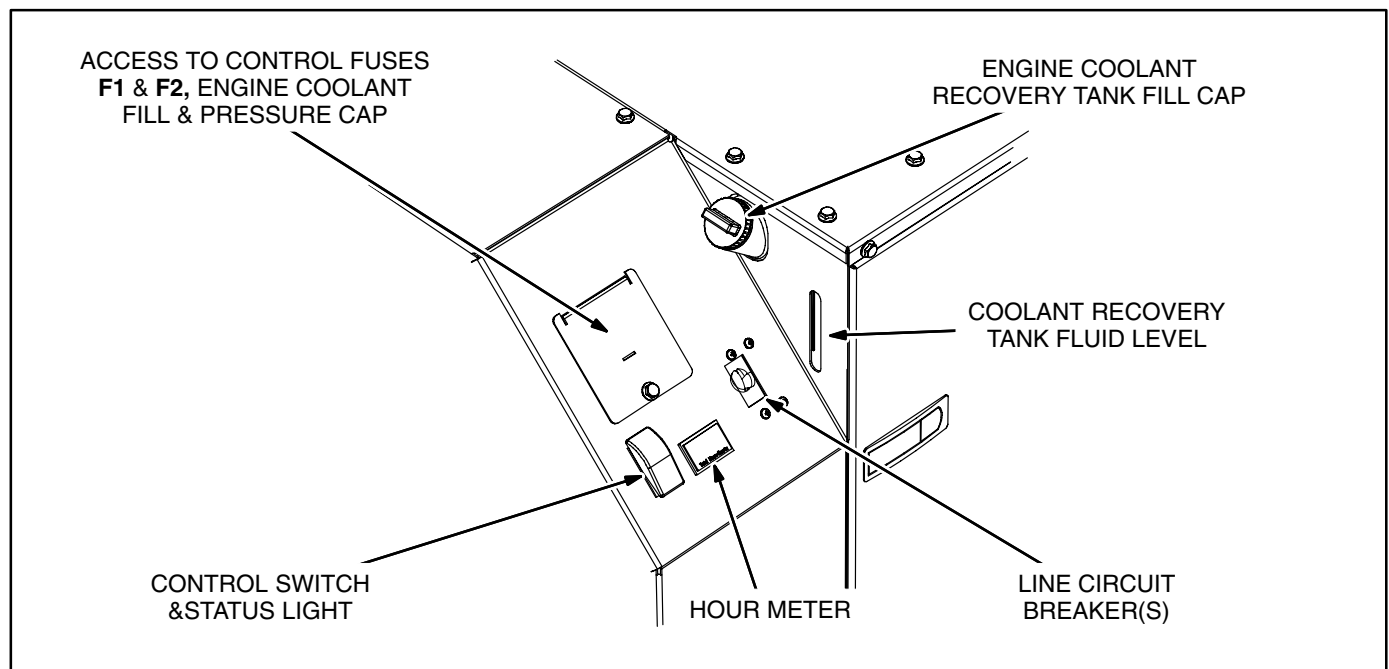


FIGURE 2-2. CONTROL PANEL (PRIOR TO SPEC C)

⚠WARNING ***EXHAUST GAS is deadly. All engine exhaust contains carbon monoxide; an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:***

- ***Dizziness***
- ***Headache***
- ***Nausea***
- ***Weakness and Sleepiness***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU EXPERIENCE ANY OF THESE SYMPTOMS, GET INTO FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the genset and do not operate it until it has been inspected and repaired.

Never sleep in the vehicle while the genset is running unless the vehicle has a working carbon monoxide detector. The exhaust system must be installed in accordance with the genset Installation Manual. Make sure there is ample fresh air when operating the genset in a confined area.

PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing the fuel filter or running the genset out of fuel. To prime the fuel system, hold the control switch down in its **Stop** position for at least 1 minute.

MANUAL STARTING

The genset can be started and stopped from the genset control panel or from a remote control panel inside the vehicle.

1. Perform the PRE-START CHECKS, prime the fuel system if necessary, and turn off the air conditioners and other large electrical loads.
2. Push the control switch to its **Start** position and hold it there while the status light blinks rapidly indicating preheat and crank. Let go when the light comes on continuously. (Depending on how cold it is, preheat can take up to 15 seconds, extending the time that the light blinks.)

⚠CAUTION ***Excessive cranking can overheat and damage the starter motor. Do not crank for more than 30 seconds at a time. Wait at least 2 minutes before trying again.***

3. See *Section 12. Troubleshooting* if the genset does not start after several tries.
4. Let the genset warm up a few minutes until it is running smoothly before connecting the vehicle electrical loads (appliances).
5. Monitor the engine gauges if the remote panel is so equipped (prior to Spec C). Normal readings during operation are as follows:
Oil Pressure: Approximate center of scale
Temperature: 160°-220° F (71°-104° C)
DC Voltage: 14-15 volts.
6. Check for fuel and exhaust leaks. Stop the genset immediately if there is a fuel, coolant or exhaust leak and have it repaired before continuing operation.

MANUAL STOPPING

Run the genset under no load for a few minutes to allow the engine to cool down and then push the control switch briefly to its **Stop** position.

AUTOMATIC STARTING AND STOPPING

The vehicle may be equipped with an inverter-charger or other automatic genset starting device. Always follow the device manufacturer's instructions and safety precautions to enable automatic genset starting.

⚠WARNING ***EXHAUST GAS is deadly. MOVING PARTS and ELECTRICITY can cause severe personal injury or death. To reduce exposure to these hazards, always disable automatic genset starting before:***

- ***Sleeping in vehicle, unless vehicle has a working CARBON MONOXIDE detector***
- ***Parking vehicle in garage or confined space***
- ***Parking vehicle for storage***
- ***Servicing genset***
- ***Servicing batteries***
- ***Servicing electrical appliances***
- ***Fueling vehicle***

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3. Periodic Maintenance

Periodic maintenance is essential for top performance and long genset life. Use Table 3-1 as a guide for normal periodic maintenance. In hot and dusty environments some maintenance procedures should be performed more frequently, as indicated by the footnotes in the table.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Onan dealer.

TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE FREQUENCY							
	Every Day	After First 50 Hours	Every Month	Every 150 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	P a g e
General Inspections	•							3-2
Check Engine Oil Level	•							3-3
Check Engine Coolant Level	•							3-8
Clean and Check Battery			• ²					3-5
Clean Spark Arrestor				• ³				3-6
Change Engine Oil and Oil Filter		•			• ^{1, 2, 3}			3-4
Check V-Belt Tension					• ⁷			8-1
Replace Engine Air Filter						• ^{1, 3}		3-5
Replace Fuel Filter						• ³		3-7
Check Coolant Anti-Freeze Protection						• ³		3-8
Flush Coolant System							• ⁴	3-8
Replace Coolant Pressure Cap							• ⁴	3-8
Replace Engine V-belt							• ^{5, 6}	8-1
Replace Coolant Hoses							• ^{5, 6}	8-1
Replace Coolant Thermostat							• ^{5, 6}	8-1
Adjust Engine Valve Lash							• ^{5, 6}	9-1
Service Fuel Injectors							• ^{5, 6}	9-1

1 – Perform more often when operating in dusty conditions.

2 – Perform more often when operating in hot weather.

3 – Perform at least once a year.

4 – Perform at least once every two years.

5 – Perform at least once every five years.

6 – Must be performed by a qualified mechanic (authorized Onan dealer).

7 – Tighten or replace the belt in accordance with the Service Manual if it can be deflected more than 1/2 in (12 mm) by thumb.

GENERAL INSPECTIONS

Inspect the genset before the first start of the day and after every eight hours of operation.

Oil Level

Check engine oil level (Figure 3-1).

Engine Coolant System

⚠ CAUTION *Operating the genset when coolant level is low can cause serious engine damage.*

Check the engine coolant level and look for coolant leaks around the bottom of the genset and on the ground below. Minor leaks that can be replenished by daily additions of coolant to the recovery tank should be repaired by a qualified service technician as soon as possible. Larger leaks are cause for shutting down the genset until it can be repaired.

Exhaust System

⚠ WARNING *EXHAUST GAS IS DEADLY! Do not operate the genset if there is an exhaust leak or any danger of exhaust gases entering or being drawn into the vehicle.*

Look and listen for exhaust system leaks while the genset is running. Shut down the genset if a leak is found and have it repaired before operating the genset again.

Look for openings or holes between the genset compartment and vehicle cab or living space if the genset engine sounds louder than usual. Have all such openings or holes closed off or sealed to prevent exhaust gases from entering the vehicle.

Replace dented, bent or severely rusted sections of the tailpipe and make sure the tailpipe extends at least 1 inch (25.4 mm) beyond the perimeter of the vehicle.

⚠ WARNING *Do not park the vehicle in high grass or brush. Contact with the exhaust system can cause a fire.*

Park the vehicle so that the genset exhaust gases can disperse away from the vehicle. Barriers such as walls, snow banks, high grass and brush and other vehicles can cause exhaust gases to accumulate in and around the vehicle.

Do not operate power ventilators or exhaust fans while the vehicle is standing with the genset running. The ventilator or fan can draw exhaust gases into the vehicle.

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply system while the genset is running and while it is stopped. Check flexible fuel hose sections for cuts, cracks, and abrasions. Make sure the fuel line is not rubbing against other parts. Replace worn or damaged fuel line parts before leaks occur.

⚠ WARNING *Diesel fuel leaks can lead to fire. Do not operate the genset if operation causes fuel to leak.*

Prime the fuel system if the genset ran out of fuel.

Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 3-5).

Mechanical

Look for mechanical damage and listen for unusual noises. Check the genset mounting bolts.

To prevent overheating and to reduce fouling with dust and debris, make sure the genset's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or remove any objects blocking the air inlet or air outlet.

CHECKING ENGINE OIL LEVEL

⚠WARNING *State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Avoid skin contact and breathing of vapors. Use rubber gloves and wash exposed skin.*

1. Park the vehicle on level ground, shut down the genset and remove the front access door.
2. Pull out the oil dip stick, wipe it clean, reinsert it and pull it out again to check the oil level (Figure 3-1).
3. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (p. 1-2). Keep the oil level between the FULL and ADD marks.

⚠CAUTION *Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the FULL and ADD marks.*

4. Reinsert the dipstick and secure the oil fill cap and front access door.

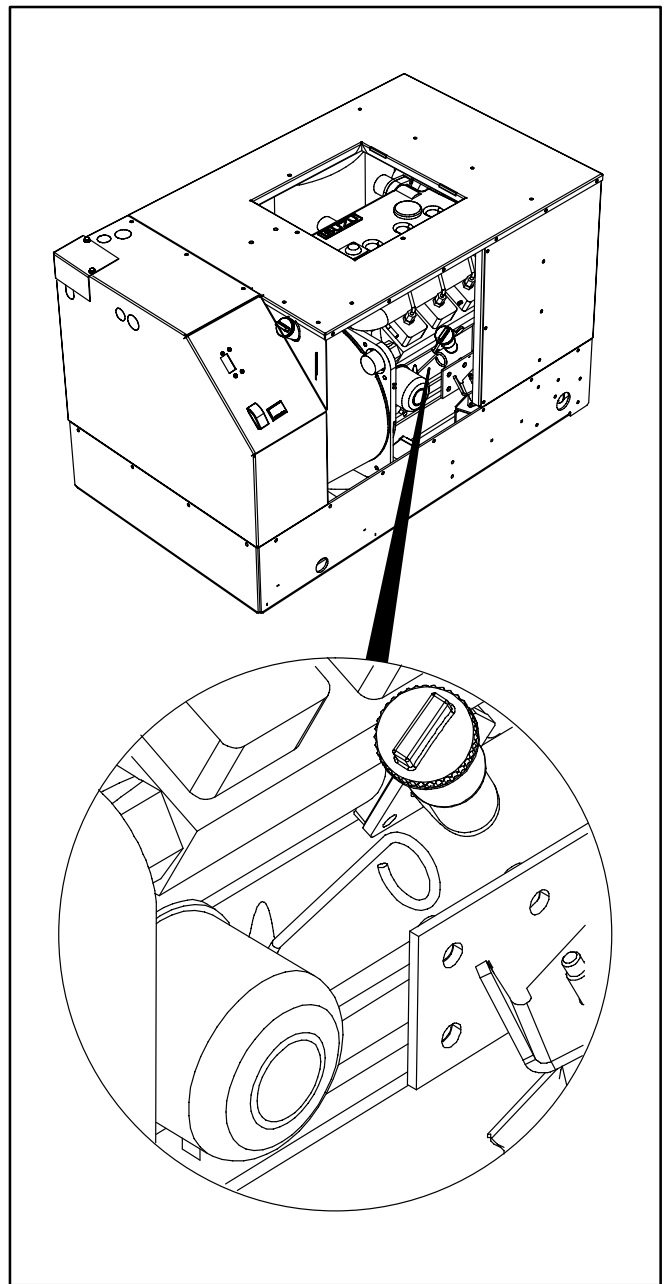


FIGURE 3-1. CHECKING ENGINE OIL LEVEL

CHANGING ENGINE OIL AND OIL FILTER

⚠WARNING *State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Avoid skin contact and breathing of vapors. Use rubber gloves and wash exposed skin.*

Refer to Table 3-1 for scheduled engine oil change. Change oil more often in hot and dusty environments.

1. Place a pan under the oil drain plug (Figure 3-2), run the genset until warm and shut it off.
2. Remove the front access door and the oil fill cap (Figure 3-1), unscrew the oil drain plug (24 mm hex head) and drain all the oil from the engine. ***Reinstall the oil drain plug securely.***
3. Spin off the oil filter canister (Figure 3-1) and clean the filter mounting surface on the engine block. Remove the old gasket if it remains.
4. Make sure the gasket is in place on the new filter and apply a thin film of clean oil to the gasket. Spin the new filter on until the gasket just touches the block. Turn it an additional 1/2 to 3/4 turn. Do not overtighten.
5. Refill with 6.7 quarts (6.3 liters) of oil, check the level (Figure 3-1) and secure the front access door.
6. Dispose of the used oil and oil filter according to local environmental regulations.

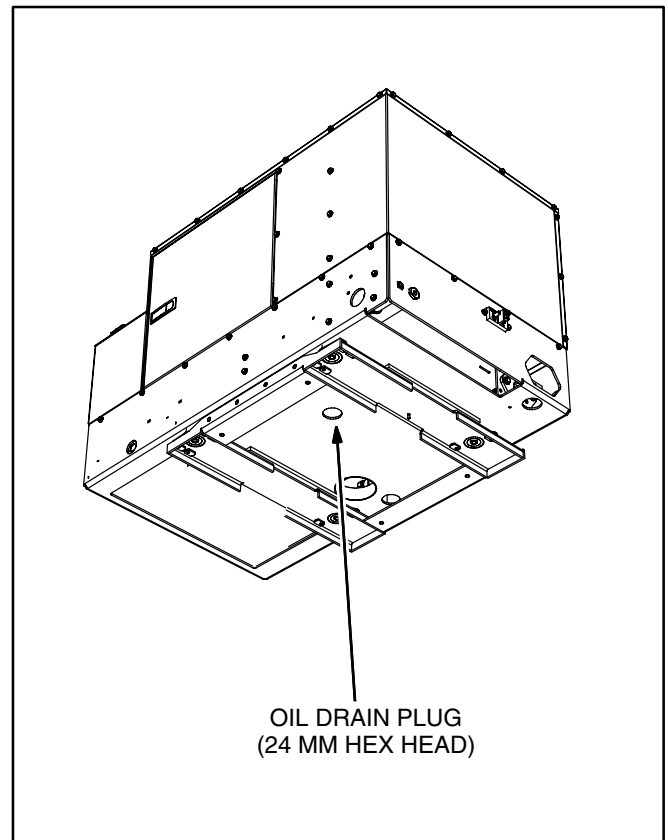


FIGURE 3-2. OIL DRAIN PLUG

MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

⚠WARNING *Arcing at battery terminals or in light switches or other equipment, and flames or sparks, can ignite battery gas causing severe personal injury—Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch work light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.*

Refer to Table 3-1 for scheduled battery maintenance, and follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high. Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.
2. Remove battery cables with a battery terminal puller.
3. Make sure which terminal is positive (+) and which is negative (–) before making battery connections, always removing the negative (–) cable first and reconnecting it last to reduce arcing.

REPLACING THE AIR FILTER ELEMENT

Refer to Table 3-1 for scheduled air filter element replacement. In dusty environments the filter element should be inspected and changed more frequently.

The air filter is accessible through the front access door (Figure 3-3). Loosen the three screws that secure the coolant recovery tank to the top housing panel (removed to show air filter) and move the tank out of the way. To change the air filter element, remove the end cap, withdraw the element and reassemble with a new air filter element. Secure the access door.

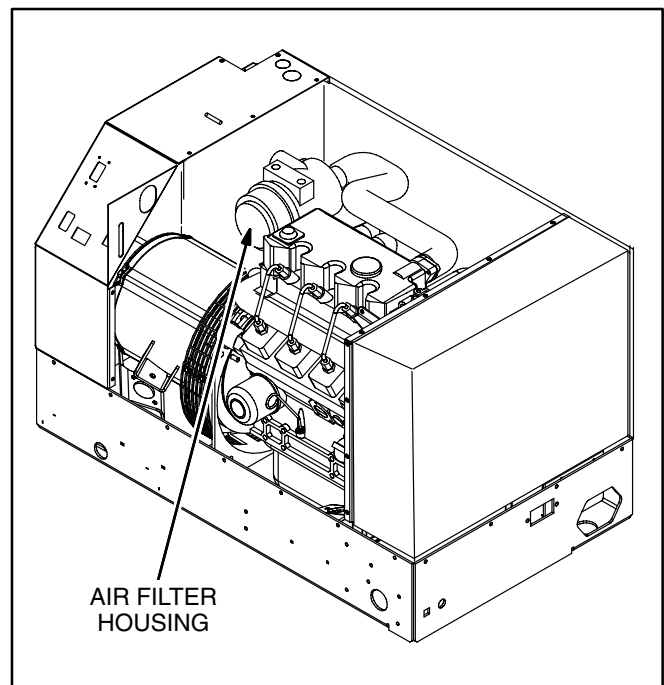


FIGURE 3-3. AIR FILTER

CLEANING THE SPARK ARRESTOR

Refer to Table 3-1 for scheduled cleaning of the spark arrestor muffler (which meets U.S. Forest Service requirements). Cleaning is required for maximum genset performance.

⚠WARNING *A hot muffler can cause severe burns. Let the muffler cool down before removing or installing the cleanout plug.*

The muffler is mounted inside the genset housing. The spark arrestor cleanout plug is located on the side of the muffler and is accessible through the top access opening (Figure 3-4). Clean out the muffler as follows:

1. Remove the top access cover.
2. Remove the cleanout plug from the muffler and secure the top access cover before running the genset (11/16 inch hex head or 7/16 inch square head plug). With the cover in place there will be enough air flow to cool the engine properly and carry the soot out of the compartment.
3. Start the genset and load it nearly to full power. Let the genset run for about five minutes to expel the soot.
4. Stop the genset, allow the muffler to cool down, reinstall the cleanout plug and secure the access cover.

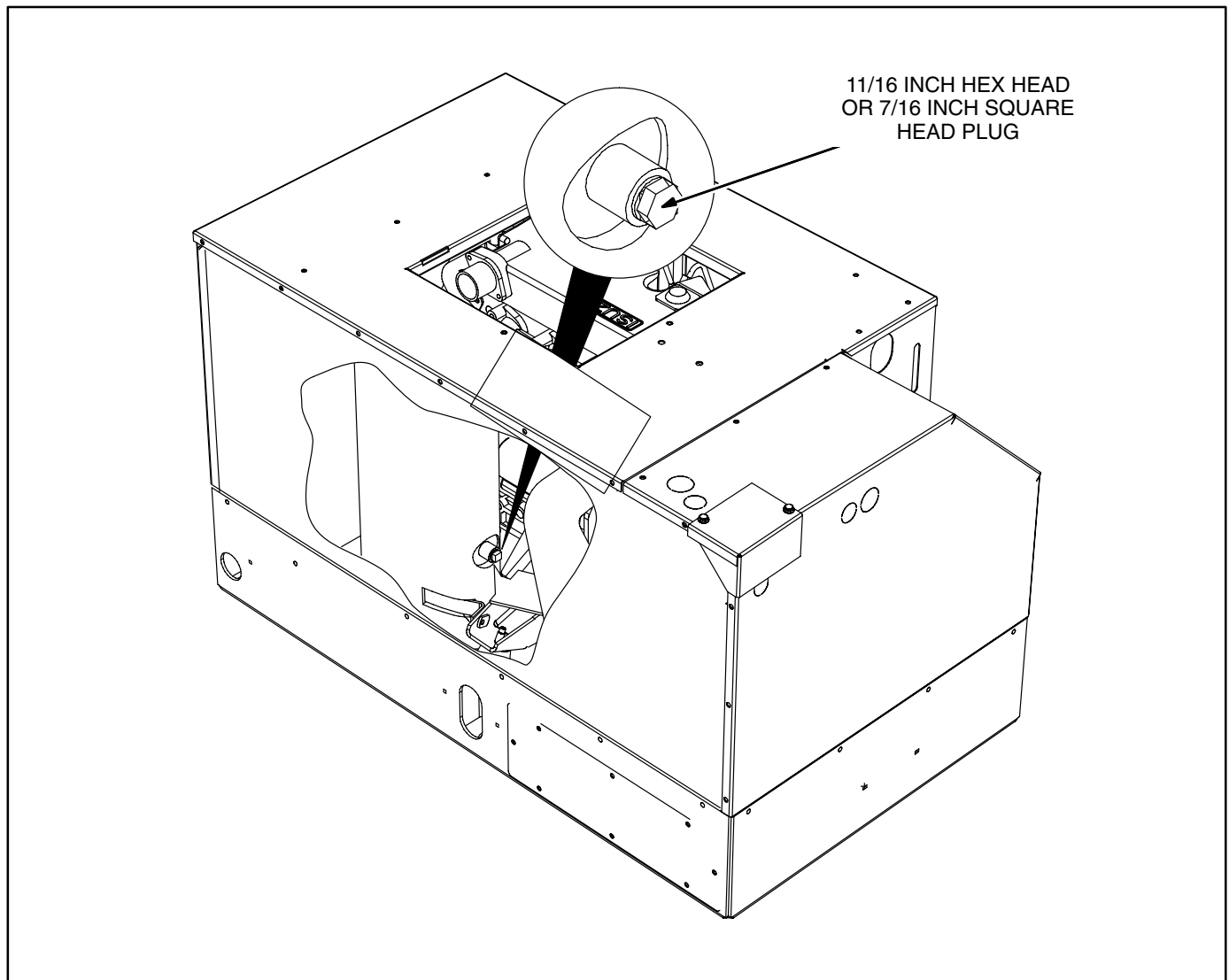


FIGURE 3-4. SPARK ARRESTOR CLEANOUT PLUG

REPLACING THE FUEL FILTER

⚠ WARNING Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near diesel fuel tanks or equipment. Keep flames, sparks, pilot lights, electrical switches, arc-producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher in the vehicle.

Close any fuel line shutoff valve before disconnecting the fuel line from the filter.

⚠ WARNING To prevent accidental or remote starting while working on the genset, disconnect the negative (-) battery cable at the battery.

See Table 3-1 for scheduled fuel filter replacement. A dirty fuel filter may be the cause of a failure to start. The fuel filter is accessible through the front access door (Figure 3-5).

⚠ CAUTION Wipe dirt off the fuel hose fittings at the fuel filter before disconnecting the hoses so as to keep dirt out of the fuel system.

Removing the Fuel Filter: Take care to spill as little fuel as possible when disconnecting the filter from

the fuel line. Close any shut off valve in the fuel line. Wipe dirt off the fuel hose fittings at the filter.

To remove the filter, disconnect the two fittings at the filter and remove the mounting nut. Apply a wrench on the filter fitting as well as on the flare nut so as not to stress the fitting. Flare nut wrenches should be used on the flare nuts so as not to round the corners on the nuts. Dispose of the fuel filter according to local regulations.

Installing the Fuel Filter: Rotate the filter half a turn around its mounting stud if the fittings interfere with the bracket. It only fits properly one way.

Connect the fuel fittings before tightening the filter mounting nut. Take care not to crossthread the fuel fittings. Thread them in by hand and tighten one flat past seating.

Prime the fuel system by holding the control switch down in its **Stop** position for at least 1 minute after replacing the fuel filter. Priming is necessary to displace the air in the new filter and fill it with fuel.

Secure the access door.

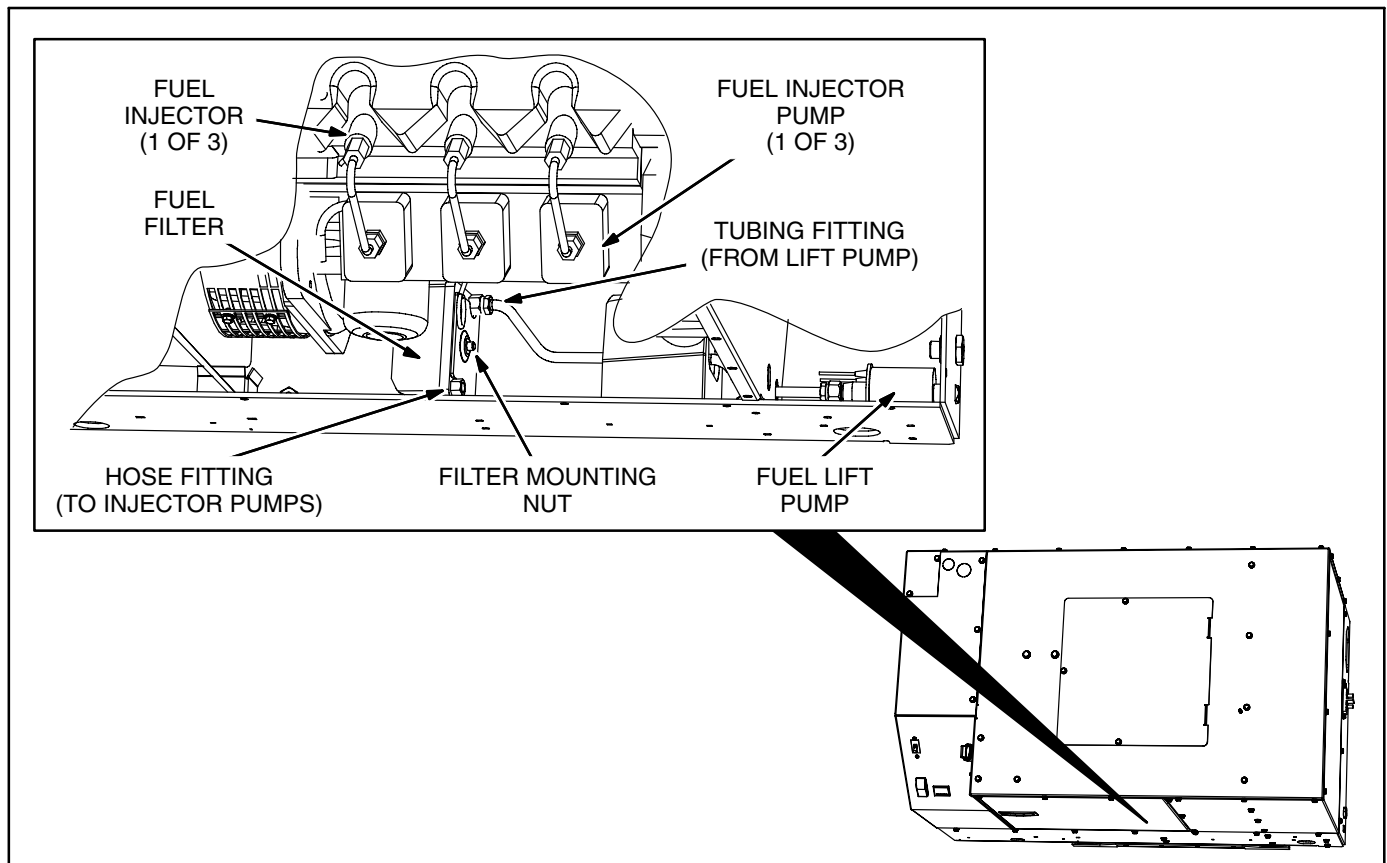


FIGURE 3-5. FUEL FILTER

CHANGING COOLANT

Refer to Table 3-1 for scheduled maintenance. The engine cooling system is filled with a 50/50 mixture of ethylene glycol anti-freeze and water when the genset leaves the factory, which is suitable for temperatures down to -34° F (-37° C).

Recommended Coolant Mixture

Use the best quality ethylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers. Use fresh water that is low in minerals and corrosive chemicals. Distilled water is best. The cooling system has a 6.1 quart (5.8 L) capacity.

Pressure Cap

Replace the pressure cap (Figure 3-6) every two years (seals deteriorate and leak). Proper cooling system pressure (14 psi) is essential for optimal engine cooling and minimal coolant loss.

Draining and Cleaning Cooling System

⚠WARNING *Hot coolant spray can cause severe burns. Let the engine cool before releasing the pressure cap or removing the drain cap.*

Let the engine cool before removing the pressure cap. Relieve any remaining pressure by turning the pressure cap slowly, without pushing down. When the pressure has been relieved, push down on the cap, turn it the rest of the way and withdraw it. Then

remove the coolant drain cap (Figure 3-6) and drain the coolant into a suitable container.

⚠WARNING *Ethylene glycol antifreeze is considered toxic. Dispose of it according to local regulations for hazardous substances.*

Flush and clean the cooling system before refilling. Radiator cleaning chemicals are available at local auto parts stores. Follow the instructions for cleaning and flushing that come with the cleaning solution.

Refilling Cooling System

Wet the O-ring in the coolant drain cap with coolant and thread the cap on just snug with a wrench. To avoid damaging the O-ring, do not torque to more than 5 lb-ft (6.8 N-m). Replace the O-ring if snugging the cap a little tighter does not stop leakage.

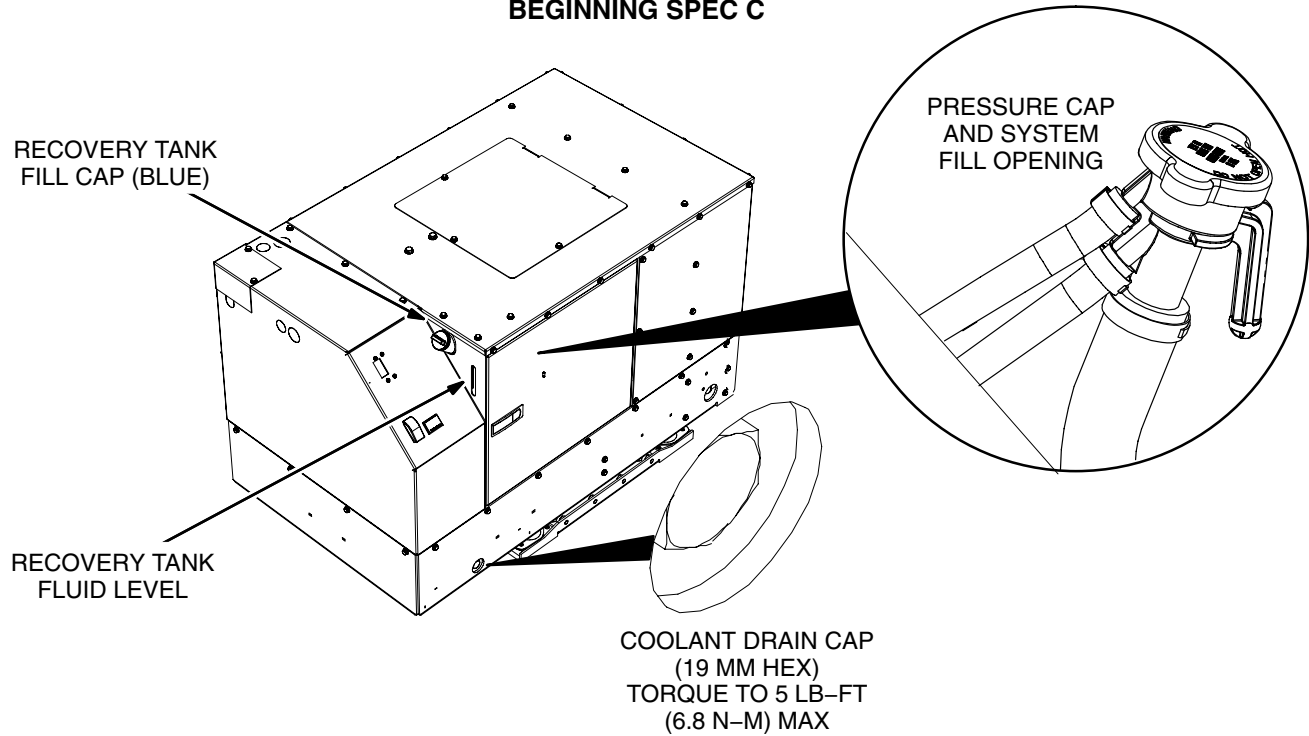
Fill the system with coolant through the fill opening. Pull the hose connected to the pressure cap assembly out as far as it will go. When the coolant level reaches the fill opening, start and operate the genset for a few minutes and shut it down. Add more coolant if necessary and secure the pressure cap.

Fill the recovery tank with coolant mixture to the COLD mark.

Coolant Level Check

Check coolant level in the recovery tank (Figure 3-6) before the first startup of each day and fill to the COLD mark if necessary.

BEGINNING SPEC C



PRIOR TO SPEC C

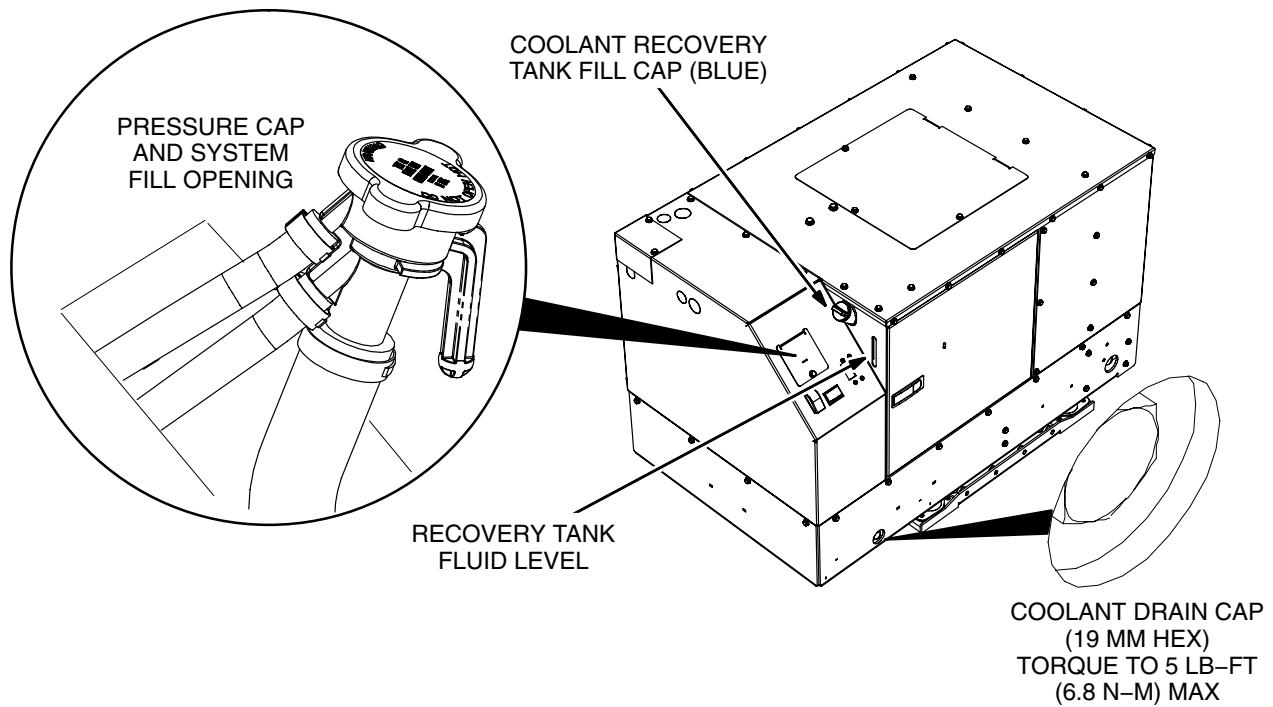


FIGURE 3-6. ENGINE COOLING SYSTEM FILL AND DRAIN CAPS

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4. Preparations for Service

SPECIAL TOOLS

The following tools are necessary for servicing the genset:

Torque wrench: 0-75 lbs-ft (0-100 N-m)

Tachometer

Digital multi-meter: AC and DC Voltage, Ohms

Load test panel and leads

SAFETY

Hazards and Their Sources

There are hazards in servicing gensets. Study *Safety Precautions* and become familiar with the hazards listed in Table 4-1. Note the following safeguards and ways of avoiding hazards:

- **Use personal protection:** Wear appropriate protective safety equipment, such as safety shoes and safety glasses.

Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.

- **Reduce the hazard:** A safe, orderly workshop area and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away from fire, flame, spark, pilot light, switches, arc-producing equipment and other ignition sources. Keep the workshop clean and well-lighted and provide adequate ventilation.
- **Develop safe work habits:** Unsafe actions cause accidents with tools and machines. Be familiar with the equipment and know how to use it safely. Use the correct tool for the job and check its condition before starting. Comply with the warnings in this manual and take special precautions when working around electrical equipment. Do not work alone if possible and take no risks.

- **Be prepared for an accident:** Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR and fire control. Take advantage of this information to be ready to respond to an accident. Learn to be safety-conscious and make safety procedures part of the work routine.

TABLE 4-1. HAZARDS AND THEIR SOURCES

Fire and Explosion	<ul style="list-style-type: none">• Leaking or spilled fuel• Hydrogen gas from battery• Oily rags improperly stored• Flammable liquids improperly stored
Burns	<ul style="list-style-type: none">• Hot exhaust pipes• Hot engine and generator surfaces• Electrical shorts
Poisonous Gas	<ul style="list-style-type: none">• Operating genset where exhaust gases can accumulate
Electrical Shock (AC)	<ul style="list-style-type: none">• Improper generator connections• Faulty wiring• Working in damp conditions• Jewelry touching electrical components
Rotating Machinery	<ul style="list-style-type: none">• Fan guards not in place
Slippery Surfaces	<ul style="list-style-type: none">• Leaking or spilled oil
Heavy Objects	<ul style="list-style-type: none">• Removing genset from vehicle• Removing heavy components

Testing the Genset Inside a Building

Make sure there is ample fresh air when operating the genset inside a building to prevent carbon monoxide asphyxiation.

⚠ WARNING **EXHAUST GAS IS DEADLY!** Engine exhaust must be vented outside if the genset is operated inside a building.

REMOVING / INSTALLING GENSET

See *Section 12 . Troubleshooting* to determine the probable cause of the problem before removing the genset for service. The genset is normally mounted in a special compartment on the floor of the vehicle or on a supporting frame. Contact the vehicle manufacturer or installer if the best way to remove the genset is not obvious.

Disconnections

1. Disconnect the negative (-) battery cable *from the battery* and then disconnect the battery cables from the genset.

⚠WARNING *Sparks and high current could cause fire and other damage to the battery, battery cables and vehicle if the loose ends of cables connected to the battery touch. Always disconnect the negative (-) battery cable from the battery before disconnecting the battery cables from the genset.*

2. Disconnect the remote control wiring harness connector at the genset.
3. Disconnect the AC output leads at the genset terminals.
4. Disconnect the exhaust tailpipe from the muffler flange.
5. Disconnect the supply and return fuel lines from the genset.

⚠WARNING *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke if you are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away.*

Removal from Vehicle

Make sure that the genset is firmly supported before loosening any mounting bolts. There are four bolt holes in the skid-base for securing the genset to the floor or supporting frame. The two lifting eyes are accessible through the access opening in the top panel of the genset. Lift the genset with both lifting eyes when using a hoist.

⚠WARNING *Gensets are heavy and can cause severe personal injury if dropped during removal. Use adequate lifting devices. Keep hands and feet clear while lifting.*

Installation in Vehicle

Generally, installation is the reverse of removal and disconnection. *Before installing the genset, repair any damage to and seal all hoses in the vapor-tight, fire-resistive barrier between the genset and coach interior.* Make sure all mounting screws, and brackets are secure and that all battery, AC output, control, exhaust and fuel connections are proper and in good repair. Perform the service checklist before placing the genset in service (*Section 13. Service Checklist*).

Use four Grade 5 screws (3/8-16 UNC) to secure the genset to the floor or frame. The screws must protrude at least 1/2 inch (10 mm) but not more than 1 inch (25 mm) into the base, as measured from the bottom surface of the base. Torque the screws to 35 lb-ft (41 N-m).

TEST STAND

When testing and servicing the genset on a workbench or test stand make sure the openings in the skid-base shown in Figure 4-1 (shaded areas) are free and clear. Also, make sure there is ample fresh air when operating the genset.

⚠ WARNING *EXHAUST GAS IS DEADLY! Engine exhaust must be vented outside if the genset is operated inside a building.*

⚠ CAUTION *Restricting the air inlet and outlet openings could lead to damage to the genset due to overheating.*

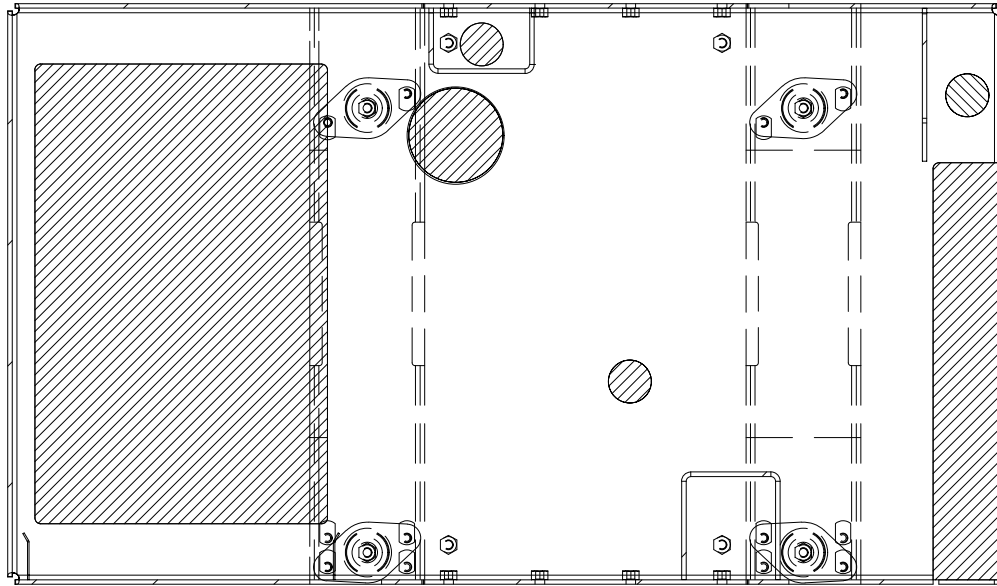


FIGURE 4-1. AIR INLET AND OUTLET OPENINGS IN BOTTOM (SHADED AREAS)

DISASSEMBLING / REASSEMBLING HOUSING

Disassembling Housing

⚠WARNING *Do not operate the genset without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. The housing is also required for proper genset cooling.*

See Figure 4-2. The housing consists of removable panels. The front and top panels include removable service doors secured by latches or screws.

Remove all the screws around the perimeter of each panel and pull the panel away. Note the sets of two and of three screw holes in the top panel which are circled. These are for the screws that secure the the air cleaner housing and the coolant recovery tank, respectively. Remove these screws before lifting the top panel away.

⚠CAUTION *The panel screws are all the same length. Do not substitute longer screws to mount the air cleaner housing or recovery tank. Longer screws can cause damage by bottoming before tight.*

Because of overlapping flanges, the top panel must be removed to remove the side panels and put back last.

To remove the end panel on the generator end of the genset:

1. Cut the wire-tie that secures the wiring harnesses to the panel.

2. Remove the two output terminal block mounting screws to free the output cables from the panel—preferable to loosening the terminal screws.
3. Loosen the screws that secure the circuit breakers to the operator's console and pull the circuit breakers and attached wiring away.
4. Disconnect the leads at the terminals on the control switch and hour meter.
5. Remove the mounting screws to free auxiliary relays K1, K2 and K3 (p. 11-6)
6. Prior to Spec C, disconnect Controller connectors P1/J1 and P2/J2 (p. 11-2).
7. Disconnect the two air intake hoses from the air intake resonator box.
8. Remove all attachment screws and pull the panel away.

Reassembling Housing

Reassembly is the reverse of disassembly. To make sure that all of the panel screw holes will line up, wait to tighten the screws until all of the panels and screws are in place.

When reassembling, torque the panel screws to 8 lb-ft (11 N-m).

Note: When securing the side service door frame to the panel on its right, the frame and panel should touch metal-to-metal. Pull the sound absorbing insulation back a little, if necessary, so that it is not pinched between the panel and frame. That way the insulation covers the slots in the door frame which would otherwise let some noise out.

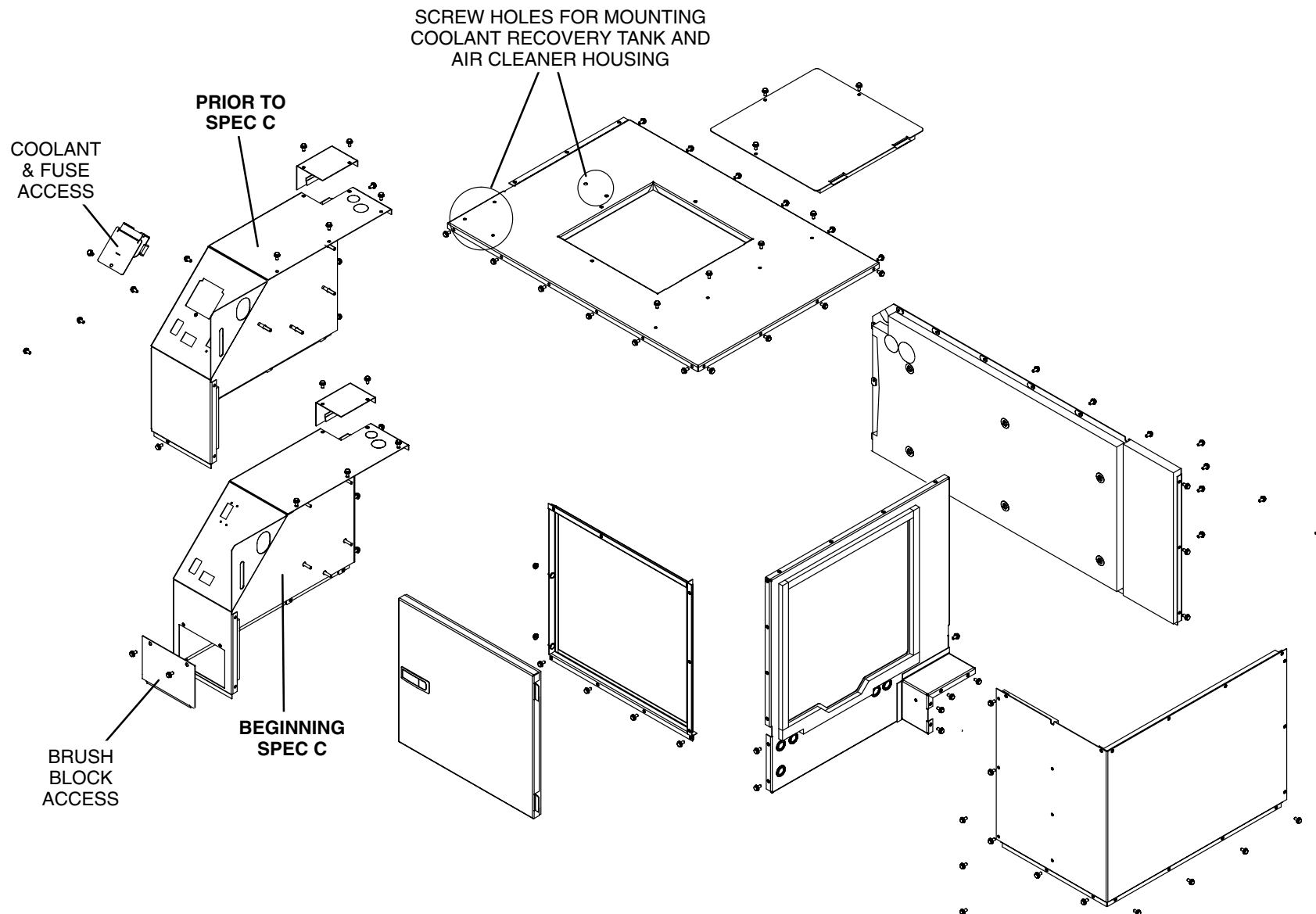


FIGURE 4-2. HOUSING PANELS

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5. Fuel System

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Figure 5-1 shows the components of the fuel system up to the connections at the engine.

⚠ WARNING *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and other sources of ignition well away. Keep a type ABC fire extinguisher handy.*

⚠ CAUTION *Always wipe dirt off fuel fittings before disconnecting them to keep dirt from entering the fuel system.*

⚠ CAUTION *Dips in the fuel lines can trap air and cause difficult priming. Secure the two fuel hoses as shown to prevent traps.*

FUEL INJECTION SYSTEM

See Engine Workshop Manual 981-0525 regarding fuel injection system service.

FUEL FILTER

The fuel filter is mounted on a bracket on the side of the base and is accessible through the front access

door. See Page 3-7 regarding fuel filter replacement.

FUEL PUMP

Fuel Flow Test

1. Disconnect the fuel return hose from the line to the supply tank and point the end into a quart (1 liter) or larger container that has volume graduations.
2. Prime the genset by pushing the Start/Stop switch to **STOP** and holding it there for the duration of the test. Flow should not be less than 200 ml (0.4 pints) per minute.
3. If flow is less than specified, replace the fuel filter. If that does not help, look for other restrictions in the fuel system. Last, replace the fuel pump. The pump is not serviceable.

Removal and Installation

The fuel pump mounting screws are on the front side of the base and the fuel pump is removeable and replaceable through the opening in the bottom of the base.

Connect the fittings on both ends of the fuel line by hand before tightening either. Use flare-nut wrenches to tighten the fittings so as not to round the corners on the nuts and two wrenches at each fitting so as not to stress the pump or filter. Tighten each fitting one flat past seating.

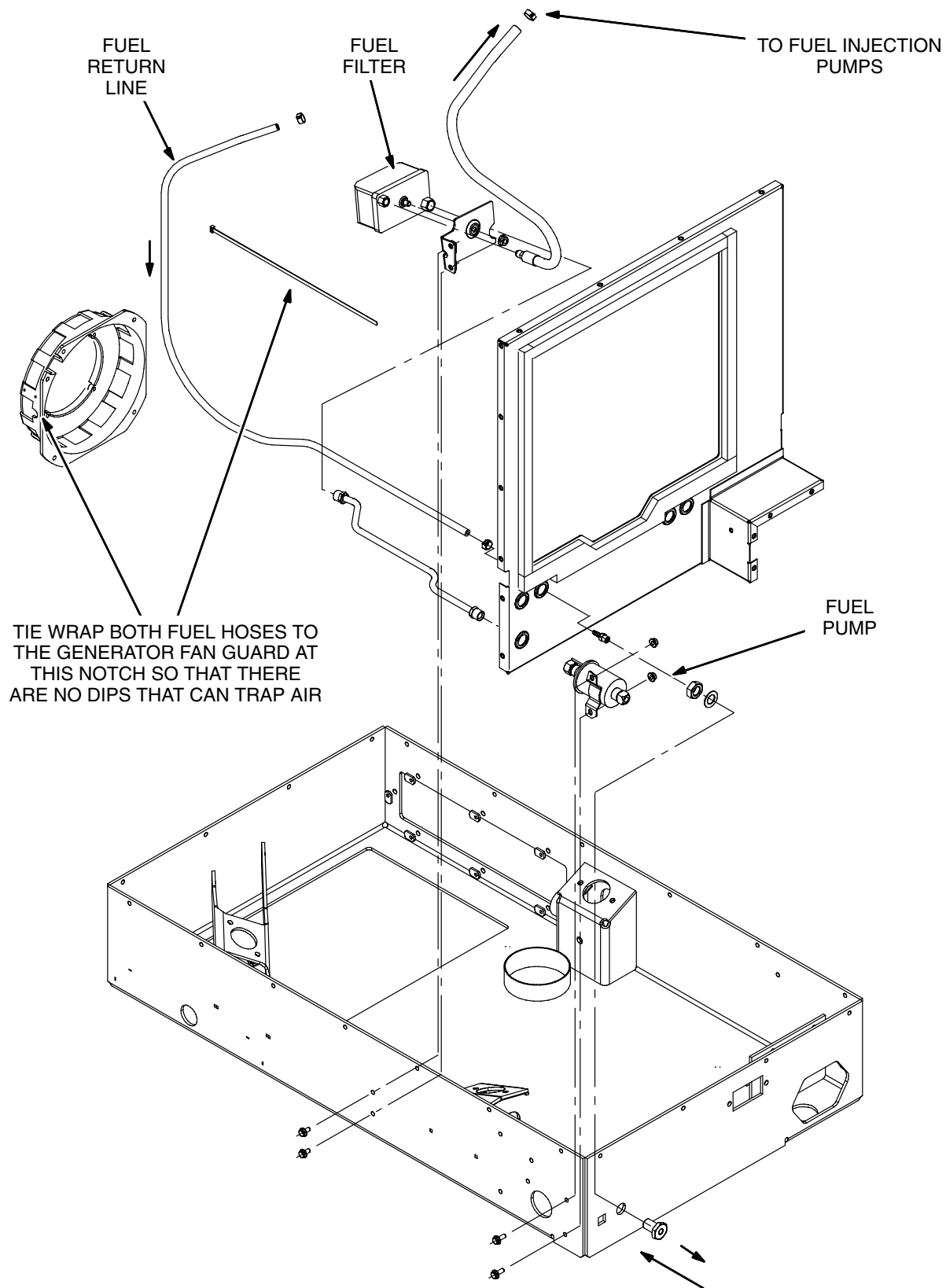


FIGURE 5-1. FUEL SYSTEM TO ENGINE

6. Air Intake System

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

Remove the top and back housing panels for ac-

cess (p. 4-4). To reassemble the air intake system, refer to Figure 6-1 for models **Beginning Spec C** or to Figure 6-2 for models **Prior to Spec C**.

⚠ CAUTION *Do not cut the engine intake air tubes to make them “fit better.” Their lengths are critical for proper noise attenuation.*

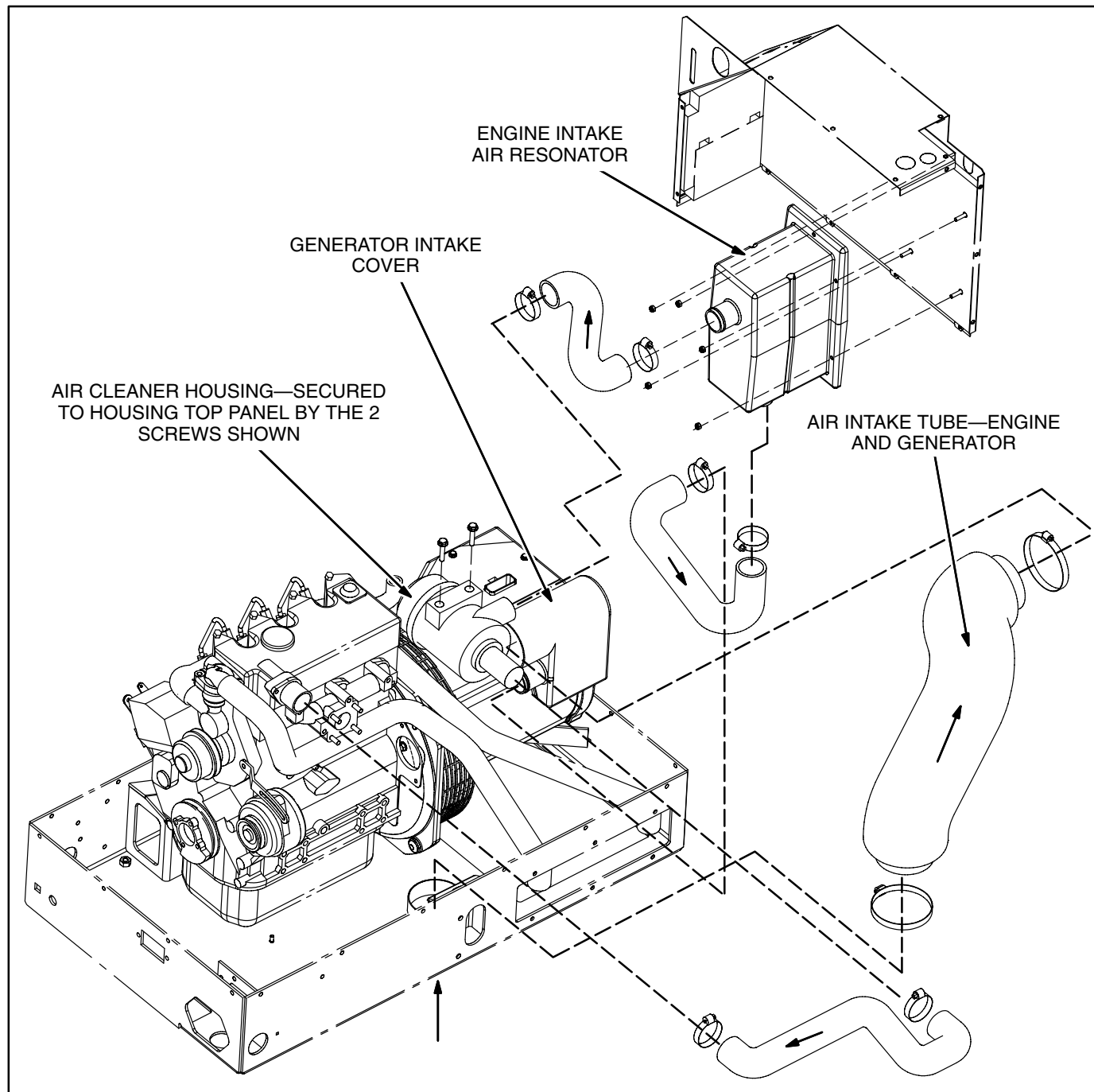


FIGURE 6-1. AIR INTAKE COMPONENTS (BEGINNING SPEC C)

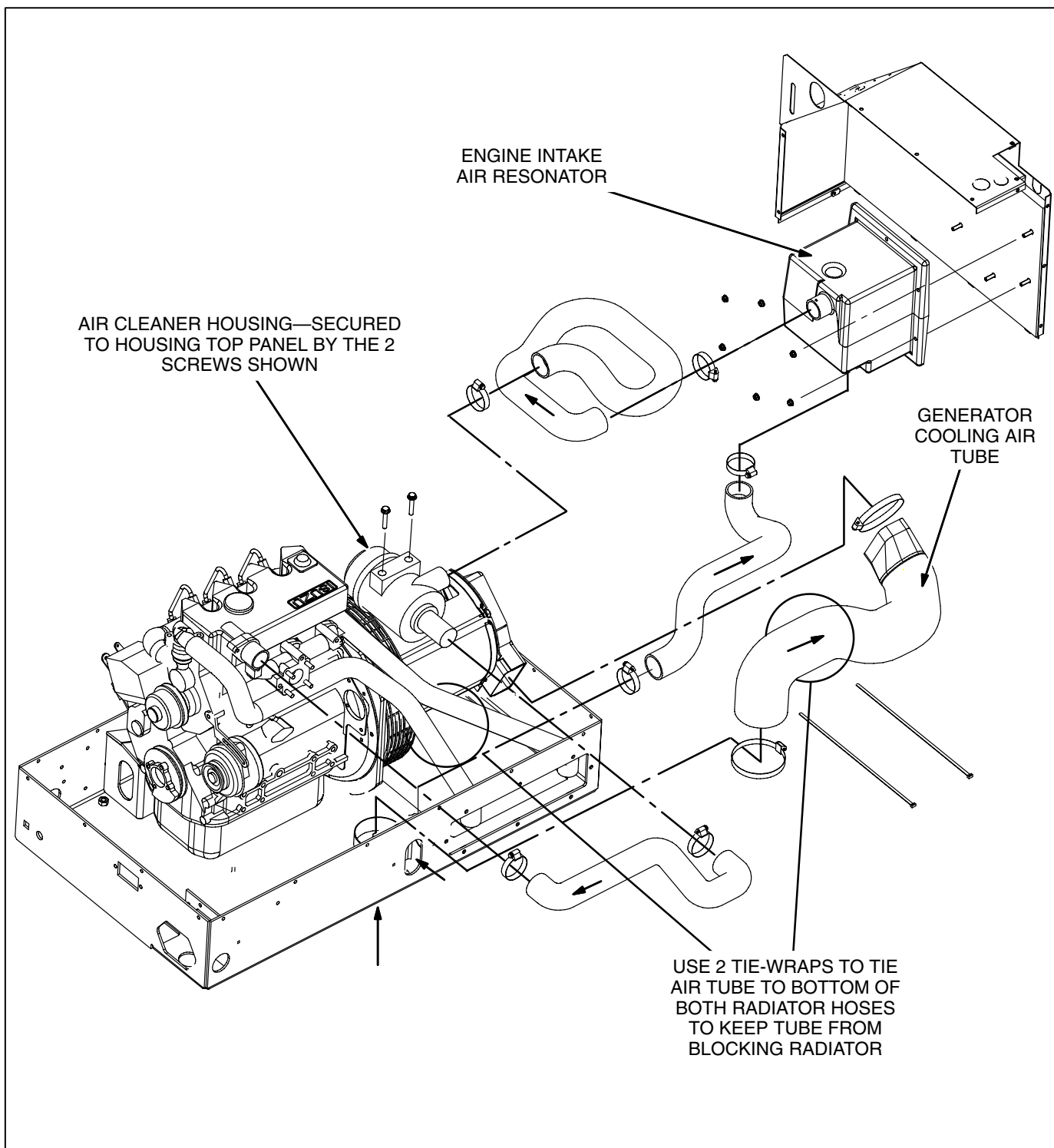


FIGURE 6-2. AIR INTAKE COMPONENTS (PRIOR TO SPEC C)

7. Exhaust System

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

The muffler is bolted directly to the outlet flange of the engine exhaust manifold and a flexible, corrugated stainless steel tube is bolted to the muffler outlet flange (Figure 7-1). The flange on the other end of the flexible tube is bolted to the base assembly.

Flanged tailpipe adaptors are available for tailpipe connections out the end, back or bottom of the genset. See the Installation Manual for important safety warnings and instructions regarding the routing and termination of the tailpipe (not supplied by Onan).

Always use new flange gaskets when connecting exhaust system components.

See Page 3-6 regarding spark arrestor cleaning.

To remove the muffler:

1. Disconnect the negative (-) battery cable *from the battery* to prevent the genset from starting

and remove the top and back housing panels (p. 4-4).

2. Disconnect the exhaust tail pipe and remove the flanged tail pipe adaptor.
3. Remove the flange screws on both ends of the flexible tube and withdraw the tube out the end of the genset.

⚠ CAUTION *The flexible tube is fragile. Take care not to bend or twist it.*

4. Remove the screws from the 2 muffler support brackets and the muffler manifold flange and withdraw the muffler.

Installation of the muffler is the reverse of removal. Use new flange gaskets for the tail pipe adaptor, flexible tube and muffler. Tighten all screws and nuts according to specifications (p. 15-1).

⚠ WARNING *Exhaust gas is deadly. The exhaust system must not leak. Liability for injury, death, damage and warranty expense due to the use of an unapproved muffler or due to modifications becomes the responsibility of the person installing the unapproved muffler or performing the modifications. Use Onan approved exhaust system parts.*

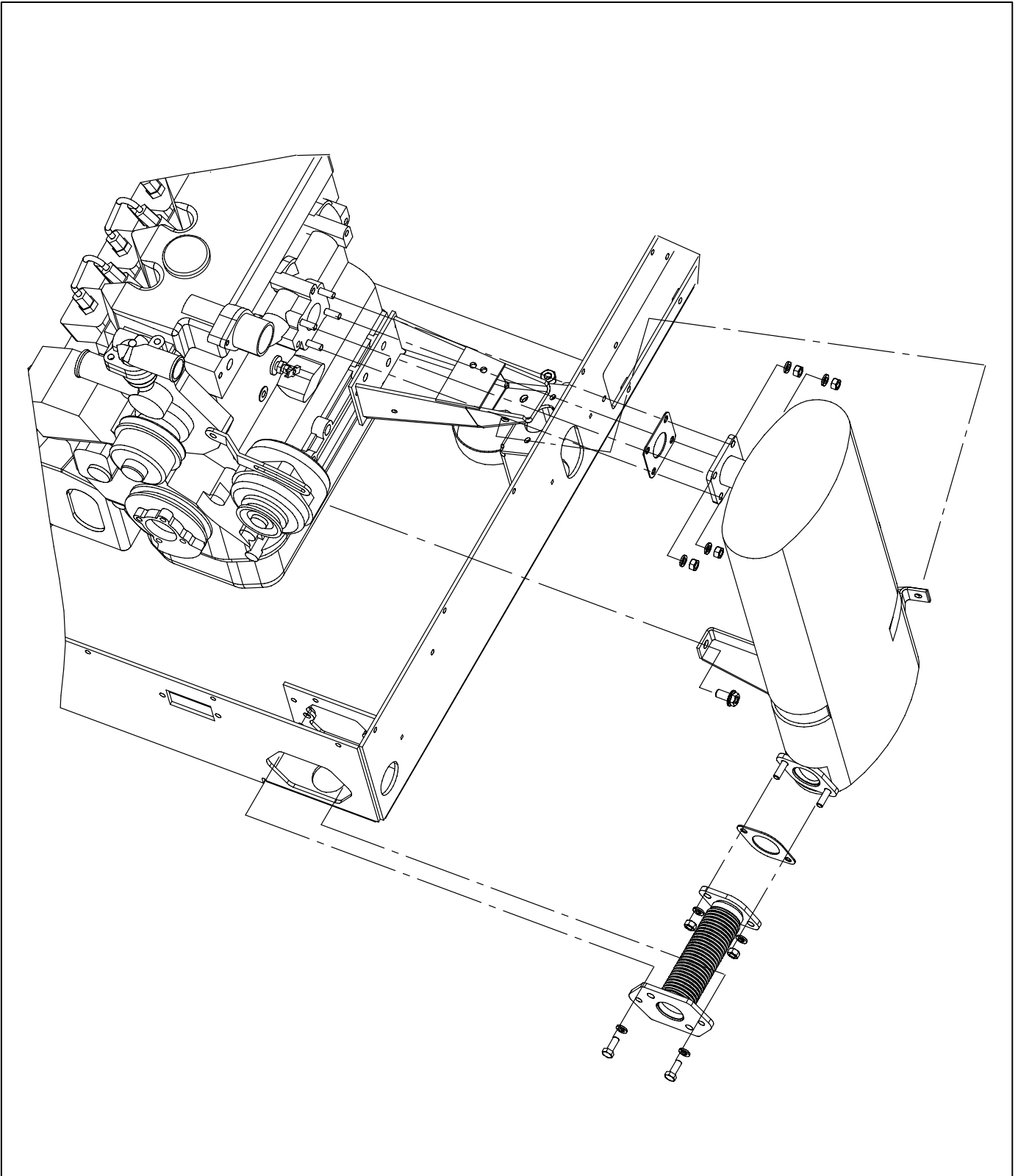


FIGURE 7-1. MUFFLER ASSEMBLY

8. Engine Cooling System

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

The genset has a liquid-cooled engine with integral, belt-driven coolant pump (Figure 8-2). The radiator is mounted horizontally in the base of the genset. The system drain plug is on the radiator end tank. The coolant recovery tank is mounted on the underside of the top housing panel.

Beginning Spec C, refer to Figure 8-1 to reassemble the cooling system components.

Prior to Spec C, refer to Figure 8-2 to reassemble the cooling system components.

A centrifugal blower (fan) is bolted on a spacer to the top belt pulley on the engine. It pulls cooling air up through the radiator and across all of the components inside the housing. The warm air is discharged out the bottom opening in the right end of the base.

See Page 3-8 regarding periodic cooling system maintenance.

See Page 9-3 regarding the coolant temperature sender.

THERMOSTAT AND PUMP

See Engine Workshop Manual 981-0525 for coolant thermostat and pump service. The fan must come off to remove the pump.

RADIATOR

To remove the radiator:

1. Disconnect the negative (-) battery cable *from the battery* to prevent the genset from starting.
2. Let the genset cool down and then drain the cooling system (p. 3-8).

⚠WARNING *Hot coolant spray can cause severe burns. Let the engine cool before releasing the pressure cap or removing the drain cap.*

3. Remove the radiator access cover on the back of the base.
4. Disconnect the two radiator hoses and withdraw the radiator out the side opening in the base.

Installation of the radiator is the reverse of removal. Replace the foam sealing strips around the opening in the base if they are damaged so that air is drawn through the radiator and not around it. Tighten all screws according to specifications (p. 15-1).

FAN (BLOWER)

To remove the fan:

1. Remove the top and end housing panels (p. 4-4).
2. Remove the fan scroll.
3. Remove the four fan hub bolts and withdraw the fan and spacer.

⚠CAUTION *The fan (blower wheel) is fragile. Do not brace against it when loosening or tightening the hub bolts.*

Installation is the reverse of removal. To prevent recirculation of air, replace the foam sealing strips around the opening of the inner bulkhead (baffle) if they are damaged. Tighten all screws according to specifications (p. 15-1).

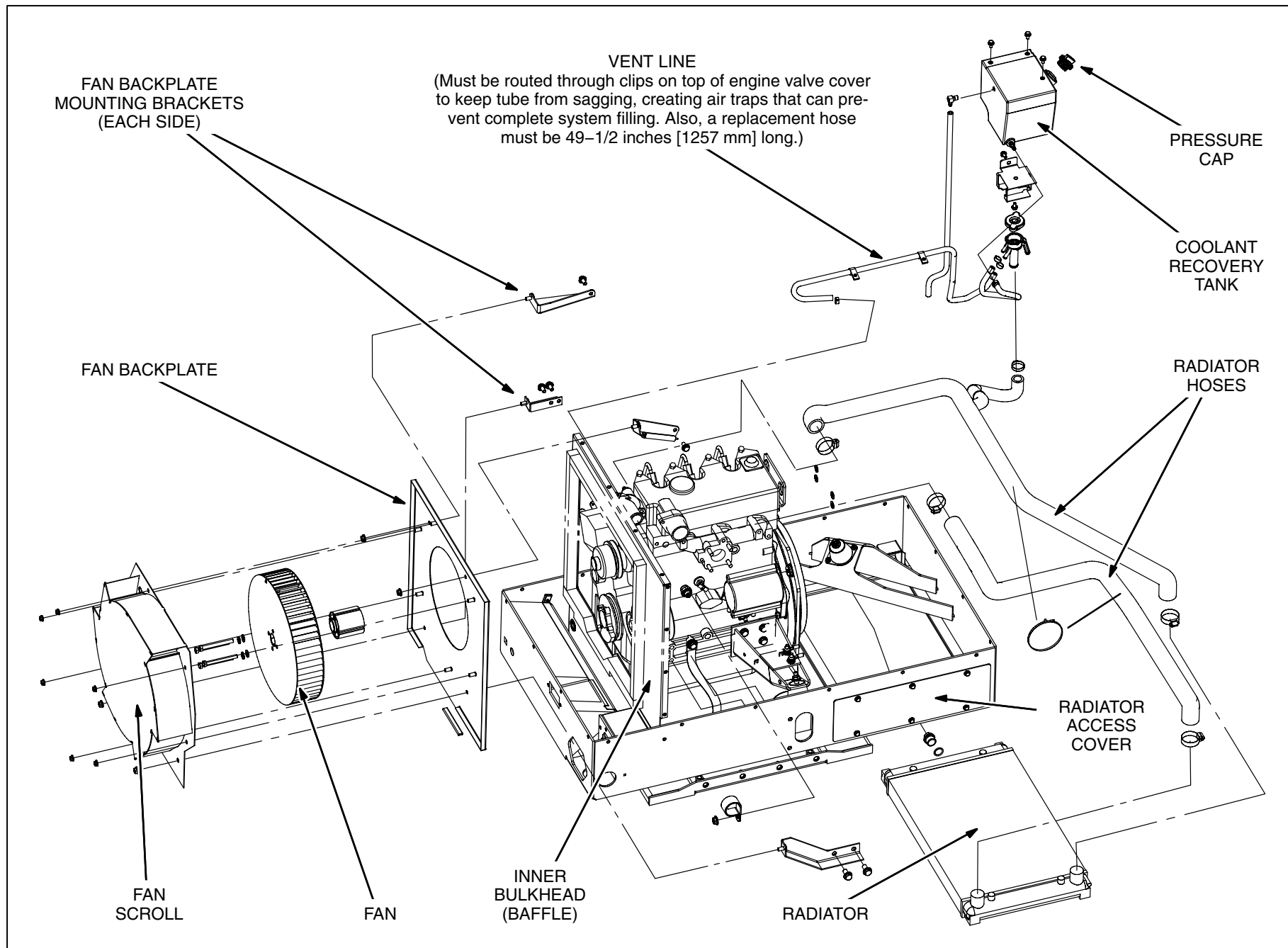
FAN BELT

Belt Tension

Remove the top genset housing panel (p. 4-4). Adjust tension so that deflection is 8-10 mm (0.3-0.4 inch) midway between the alternator and pump pulleys when a force of 10 kg (22 pounds) is applied.

Belt Replacement

Remove the fan and then install the new belt and adjust its tension.

**FIGURE 8-1. ENGINE COOLING SYSTEM (BEGINNING SPEC C)**

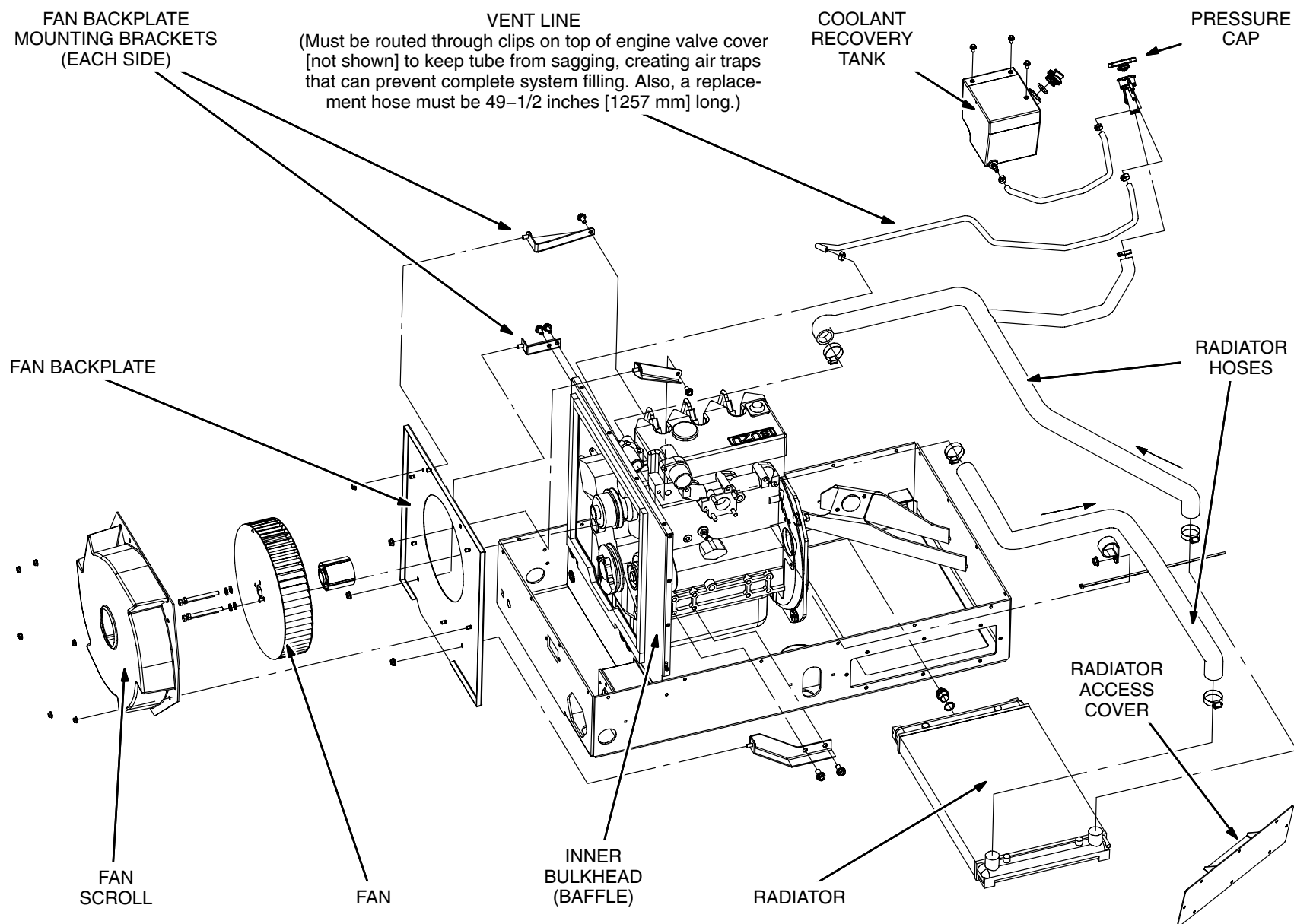


FIGURE 8-2. ENGINE COOLING SYSTEM (PRIOR TO SPEC C)

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9. Engine and Accessories

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

ENGINE

See Engine Workshop Manual 981-0525 for servicing the engine proper: adjusting valve clearance (lash), servicing the fuel injection system, replacing the glow plugs, cleaning the crankcase breather assembly, replacing the coolant thermostat and pump and overhauling the engine.

Removal

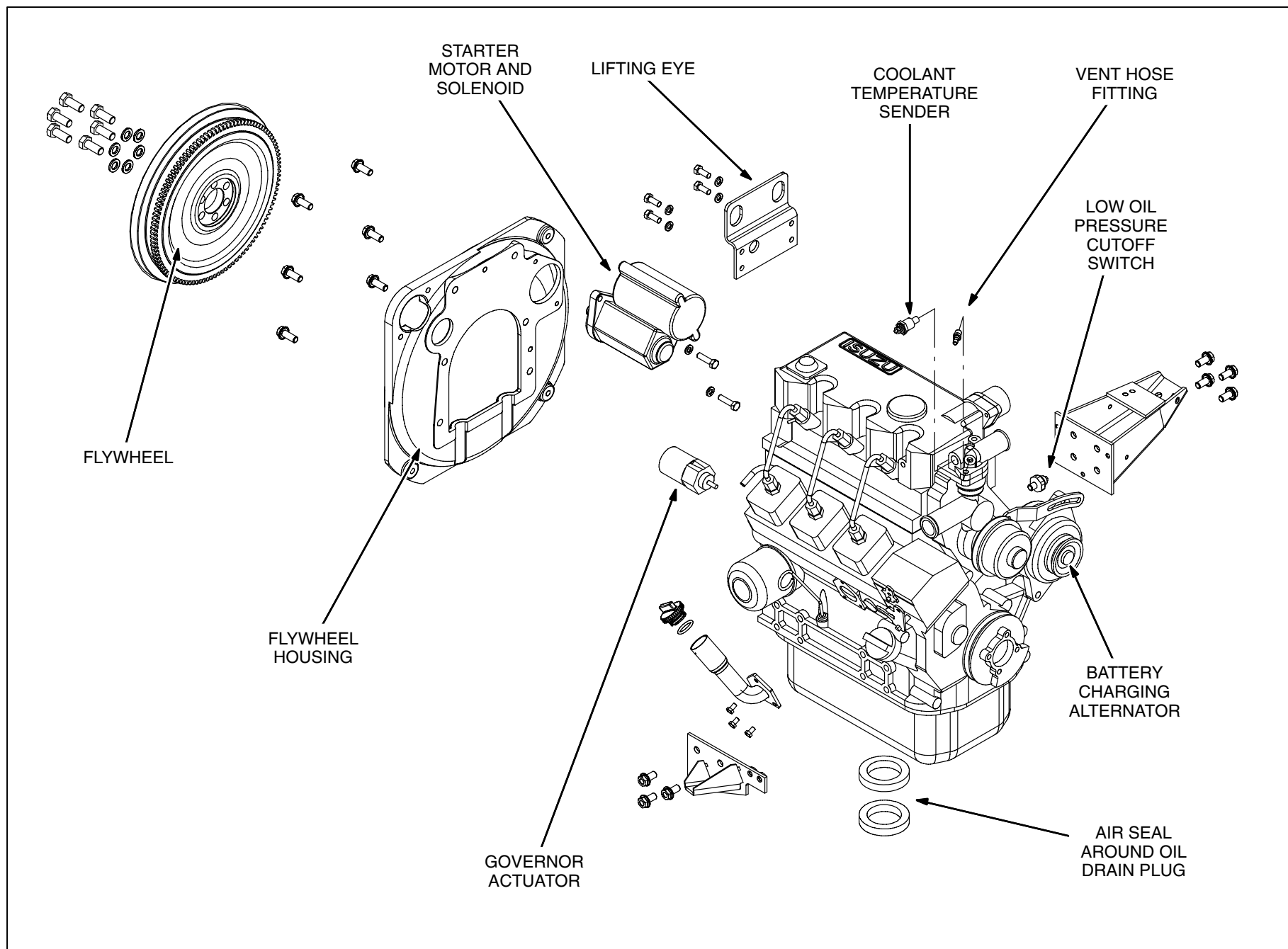
The engine-generator assembly and wiring harnesses should be removed as an assembly from the genset if it is necessary to remove either the engine (Figure 9-1) or the generator (Figure 10-1 or 10-2). To do so:

1. Remove all of the housing panels except the inner bulkhead (p. 4-4), leaving the wiring harnesses attached to the engine-generator assembly.
2. Drain the cooling system, disconnect the radiator and vent hoses from the engine and remove the blower (fan) assembly (p. 8-1).

3. Remove the radiator (p. 8-1) for access to the bolt head of the generator isolation mount.
4. Disconnect the generator cooling air tube from the generator (p. 6-1 or 6-2).
5. Disconnect the battery cables and base grounding strap from the engine (on starter side).
6. Disconnect the wiring harness lead to the fuel pump.
7. Disconnect the supply and return fuel hoses at the engine (p. 5-2).
8. Disconnect the flexible connector from the muffler outlet flange (p. 7-2).
9. Attach a hoist of sufficient capacity to the lifting eye, take up the slack and remove the center bolts of the three isolation mounts. Lift the engine-generator assembly away.

Installation

Installation is the reverse of removal. Make sure the air seal ring is in place around the oil drain hole in the base to keep air from bypassing the radiator. (The engine-generator compartment is under a partial vacuum.) Tighten all screws to specifications (p. 15-1).

**FIGURE 9-1. ENGINE AND ACCESSORIES**

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

ENGINE SENSORS

The engine is equipped with a coolant temperature sender and low oil pressure cutout switch (Figure 9-1). The associated fault codes (Section 12. Troubleshooting) are as follows:

- **No. 1** - Engine Over Temperature
- **No. 2** - Low Oil Pressure
- **No. 23** - Faulty Low Oil Pressure Cutout Switch
- **No. 24** - Faulty Engine Temperature Sender

Coolant Temperature Sender

The sender is accessible through the front access opening. Replace the sender if resistance is not approximately 1300 ohms in ice water, 700 ohms at room temperature or 57 ohms in boiling water. Use thread sealant and engage at least two threads when reassembling.

Oil Pressure Switch

The switch is accessible through the top access opening with the manifold air hose disconnected

and moved out of the way. Replace the switch if it is not closed (ground continuity at the terminal) when the engine is not running or if the switch does not open when oil pressure rises to 14 psi (96 kPa).

BATTERY CHARGING ALTERNATOR

The battery charging alternator (Figure 9-1) is removeable after the fan assembly and backplate are removed (p. 8-2 or 8-3). Adjust fan belt tension and tighten the mounting bolts according specifications (p. 15-1) when reassembling.

STARTER MOTOR

The starter motor (Figure 9-1) is removeable through the top access opening. Tighten the mounting bolts according specifications (p. 15-1) when reassembling.

GLOW PLUGS

Refer to engine Workshop Manual 981-0525 when replacing the glow plugs, which are accessible through the top access opening.

Note: If a glow plug does not come out after unscrewing it, or the end has broken off, it will be necessary to remove the engine head. Glow plugs can swell if preheat voltage is greater than 14 volts, such as when a battery booster is used for starting.

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

GOVERNOR ACTUATOR

The governor actuator (Figure 9-1) is removeable through the front access opening. Disconnect the actuator and unscrew it from the engine block. When reassembling, use Loctite 587 "ultra-blue" sealant or equivalent on the seat. **Do not apply the sealant to the threads.** Replace the actuator if:

- Electrical resistance across its terminals is not 2.8 to 2.9 ohms.
- The plunger does not pull in when **B+** (12 VDC) is applied across its leads.
- The plunger does not move in and out smoothly when pushed in by hand.

HIGH-IDLE SPEED

Reset high-idle speed if the stop screw seal has been broken or internal governor parts have been replaced or are worn. To reset high-idle speed:

1. Remove the top housing panel (p. 4-4) for access to the stop screw (Figure 9-2).
2. Remove the governor actuator to allow operation at full fuel rack, but leave it connected to keep Fault No. 19 from preventing Start. Plug the opening to keep oil from splashing out.
3. Disconnect the fuel pump and power it directly with a 12 volt battery to keep the engine running when Fault No. 12 or 14 occurs.
4. *Disconnect all loads from the genset to protect them from overfrequency* and start the genset. Adjust the stop screw to obtain 67.3-68.3 Hertz (2019-2049 rpm). **TO STOP THE ENGINE,** disconnect the fuel pump from the battery.

⚠CAUTION *With the housing top off the engine could overheat if run longer than 5 minutes or so. Let is cool down, if necessary, before continuing the test.*

5. Check speed with the top panel and access cover on. Frequency should rise slightly to 68-69 Hertz (2040-2070 rpm). Repeat if necessary and seal the adjusting threads with paint.
6. Re-install the actuator, reconnect the fuel pump and secure the housing top and access cover.

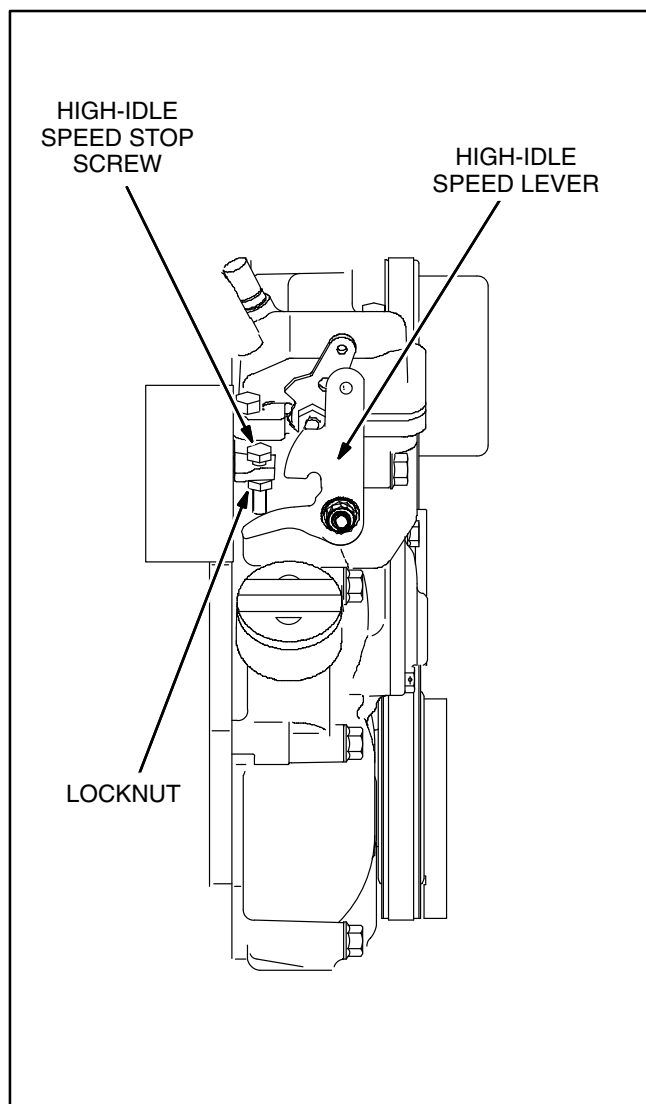


FIGURE 9-2. HIGH-IDLE SPEED STOP SCREW

10. Generator

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

GENERATOR WINDING TESTS

Testing Winding Insulation Resistance

Testing for Winding-to-Winding and Winding-to-Ground Shorts: A digital ohmmeter can be used (highest scale) as a preliminary check for a grounded Stator, Quadrature or Field Winding or for a short between Stator (Main) and Quadrature windings. The meter should indicate infinite resistance.

A 500 VDC megger is recommended for finding winding-to-winding or winding-to-ground shorts. Resistance between windings or to ground should be not be less than 1 megohm.

Testing Stator Windings with a Megger: A 500 VDC megger is recommended for testing Stator Winding insulation resistance. Disconnect **T2** and **T3** from the grounding screw on the engine mounting bracket (p. A-3) to isolate the windings from ground, and separate the two parts of generator connector **P3/J3** to isolate the control board from the DC test voltage. Apply one side of the DC test voltage to both windings (connect to either end) and the other side to a good generator ground (stator laminations) for 10 minutes and record resistance values at one minute and at 10 minutes.

A resistance value of at least 5 megohms should be obtained for a new stator with dry windings. The polarization index (the ratio of the resistance reading at 10 minutes to the reading at one minute) should also be at least 2. For a genset that has been in service, the resistance value should not be less than 1 megohm, nor the polarization index less than 2.

If the readings are low, or the genset has been in storage for a long time in a high-humidity environment, the test should be repeated after the windings have been dried. The most effective way of drying the stator windings, if the genset is operable, is to run it under full load for at least one hour.

Testing Winding Resistance

Use a **Digital Ohmmeter** to check for open or shorted Main (Stator), Quadrature or Field Windings. Use a **Wheatstone Bridge** having a precision of at least 0.001 ohm to measure Stator Winding resistance.

Replace a rotor or stator that has winding resistances outside Table 10-1 tolerances.

Stator Windings: Check Stator Winding resistance across the AC output terminal block: **TB2-1—TB2-3** and **TB2-2—TB2-3**. Make sure circuit breaker **CB1/CB2** is ON.

If resistance is within Table 10-1 tolerances, the whole AC output circuit is probably sound.

If resistance is high, check resistance directly across the winding leads, which are connected at **CB1/CB2** and at the grounding screw on the engine mounting bracket (p. A-3). Service as necessary by tightening connections or servicing the generator, AC harness (p. A-3) or circuit breakers (p. 11-6).

Field and Quadrature Windings: Separate the two parts of generator connector **P3/J3** for access to the field windings (**P3-7—P3-8**) and quadrature windings (**P3-3—P3-6**). Resistance must within Table 10-1 tolerances. If field resistance is high, first service the brushes and slip rings (p. 10-4) and repeat the test. Then, if necessary, service the rotor.

TABLE 10-1. WINDING RESISTANCES

WINDING	RESISTANCE (OHMS) @ 70° F (21° C)		
	Beginning Spec C		Prior to Spec C
	HDCAA HDCAC	HDCAB HDCAD	All Models
T1-T2, T3-T4	0.197-0.241	0.178-0.218	0.197-0.241
Q1-Q60 (P3-3 to P3-6)	1.99-2.42	1.89-2.31	1.99-2.42
Rotor (P3-7 to P3-8)	19.4	22.5	19.4

Note: Even though winding resistance may be within the tolerances of this Table, replace the Rotor or Stator if winding-to-winding or winding-to-ground resistance (winding **insulation** resistance) is less than 1 megohm. (An ohmmeter must indicate an *open circuit* or *infinite resistance* between windings or between any winding and ground.)

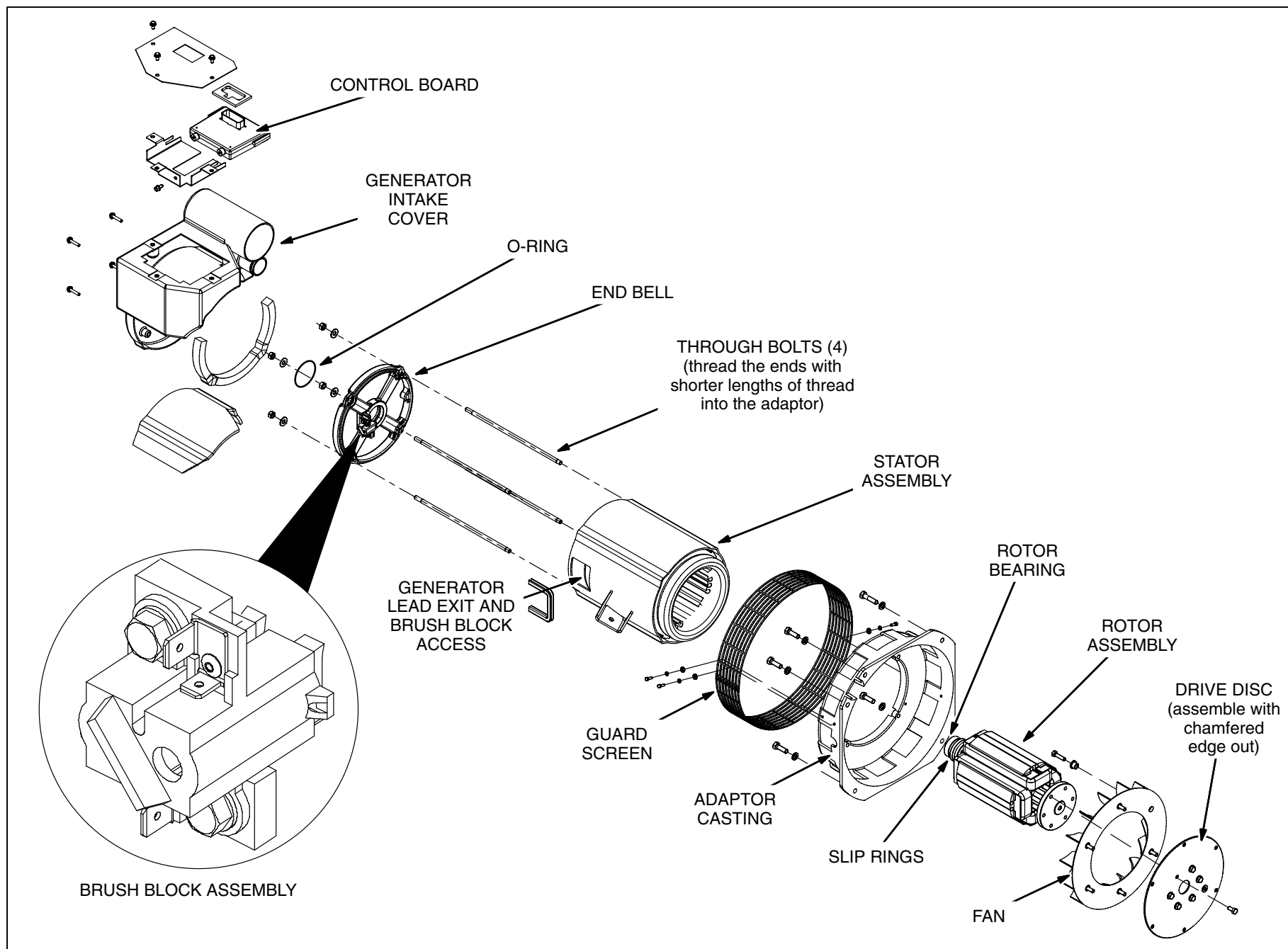


FIGURE 10-1. GENERATOR (BEGINNING SPEC C)

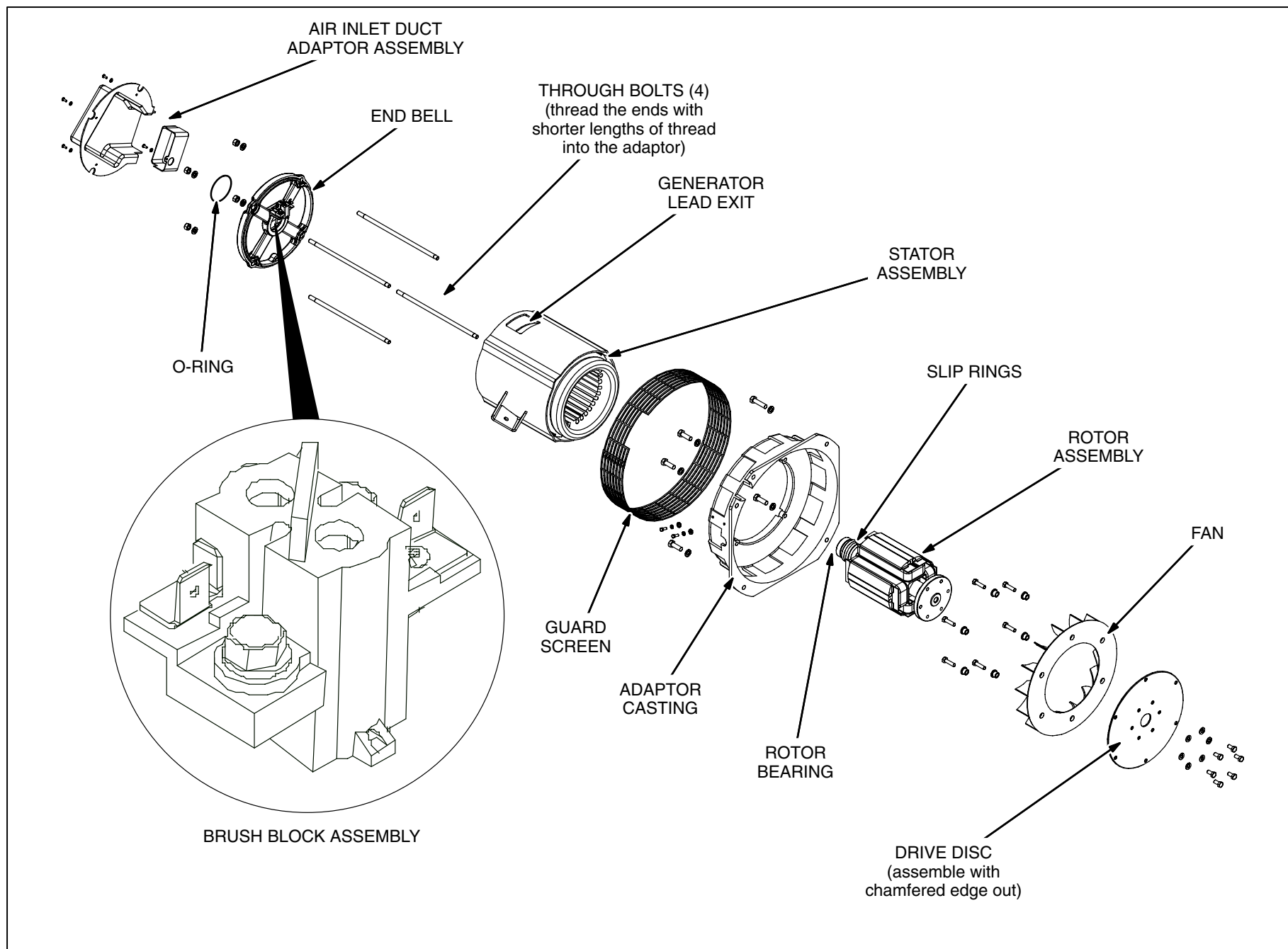


FIGURE 10-2. GENERATOR (PRIOR TO SPEC C)

GENERATOR SERVICE

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Brushes and Slip Rings

Access Beginning Spec C: Remove the brush block access cover (p. 4-4) for access to the brush block assembly and slip rings.

Access Prior to Spec C: Remove the housing end panel (p. 4-4) and the generator air duct adaptor assembly (Page 12-1) for access to the brush block assembly and slip rings.

Checking for Wear: Check brush wear by marking off a piece of wire at 1 inch (25 mm) and inserting it into each of the two holes in the top of the brush block from which the pig tails exit. Replace the brush if the wire can be inserted more than 1 inch (25 mm). (Make sure the wire rests on top of the brush and not on part of the spring.)

Cleaning Up Slip Rings: If the slip rings are grooved or pitted, try cleaning them up with a commutator stone while cranking the engine. (Connect the starter motor directly to a battery and the starter solenoid to a remote start switch.) The rotor will have to be removed if the slip ring assembly has to be replaced.

Replacing Brush Block: When replacing the brush block assembly, center the brushes on the slip rings before tightening the two mounting screws. Make sure to reconnect the lead marked **F1** to the outboard brush and the lead marked **F2** to the inboard brush.

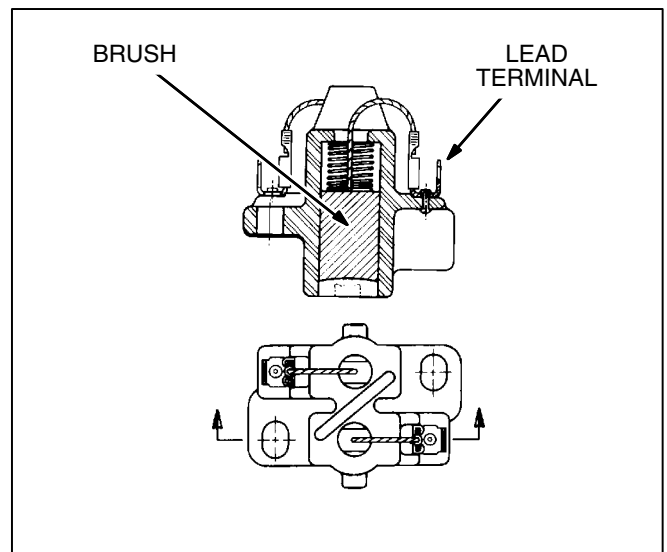


FIGURE 10-3. BRUSH BLOCK ASSEMBLY

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

Removing the Generator

Remove the engine-generator assembly as an assembly from the genset (p. 9-1) and then remove the generator from the engine, as follows:

1. Remove the air inlet assembly (Figure 10-1 or 10-2).
2. Disconnect the generator leads attached to the grounding screw on the engine mounting bracket (Page A-3) and separate the two parts of generator connector **P3/J3**.
3. Remove the brush block assembly or lift the brushes and insert a wire to keep the brushes up and out of the way while disassembling and reassembling the generator.
4. Loosen the four through bolt nuts and remove the end bell and stator assemblies.
5. Remove the adaptor casting from the flywheel housing and then the rotor from the flywheel.

Installing the Generator

Installation is the reverse of removal. Tighten all nuts and bolts according to specifications (p. 15-1) and note the following:

1. Make sure the chamfered edge of the drive disc faces the flywheel.
2. Make sure the ends of the through bolts with the shorter lengths of thread are threaded into the adaptor casting.
3. Make sure the O-ring is in place in the bearing bore of the end bell. Grease the bore lightly to make assembly easier.
4. Before securing the the air inlet adaptor assembly, make sure the brush block assembly is in place (Brushes and Slip Rings) and that the wire holding up the brushes has been removed.

Replacing the Rotor Bearing

Use a gear puller if it is necessary to remove the rotor bearing. If the slip ring assembly is being replaced, install the new assembly before pressing on the bearing. Press a new rotor bearing on flush with the end of the rotor. Apply Loctite #680 adhesive to the shaft and Loctite #747 activator to the bearing mating surface.

Replacing the Slip Ring Assembly

Remove the rotor bearing and unsolder the two field leads if it is necessary to remove the slip ring assembly. Press a new slip ring assembly on making sure the key is in place and soldered the field leads to the slip ring assembly.

ADJUSTING VOLTAGE

Beginning Spec C, voltage is adjustable by means of the control switch. Rapidly pressing the switch to **START** 6 times *during the first minute after startup* puts the genset controller into *voltage set mode*. The status indicator lamp blinks once every second to confirm voltage set mode. The controller will resume normal operating mode 20 seconds after the last adjustment.

⚠WARNING **HAZARDOUS VOLTAGE!** *Touching uninsulated live parts inside the genset or connected equipment can result in severe personal injury or death. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and use tools with insulated handles.*

To adjust voltage:

1. Disconnect all generator loads and connect accurate meters to measure AC voltage and frequency.

2. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds.
3. Rapidly press the control switch to **START** 6 times within 10 seconds.
4. **To adjust voltage up**, press the control switch to **START** and release quickly. Each time the switch is released, voltage will rise approximately 0.6 volt.
5. **To adjust voltage down**, press the control switch to **START** and release in 1 second. Each time the switch is released, voltage will drop approximately 0.6 volt.
6. Normal operation will resume in 20 seconds after the last adjustment. The last adjustment will be retained by the controller.

Note: If a fault shutdown occurs or the control switch is pressed to **STOP** during voltage set mode, voltage adjustments will not be stored in controller memory.

11. Control

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

CONTROL BOARD (CONTROLLER)

The Control Board is an integrated microprocessor-based engine and generator control that provides all the control, monitoring and diagnostic functions required to operate the genset.

Control Board (Beginning Spec C)

Location and Mounting: Refer to Figure 11-1 for control board location and mounting and to Pages A-1 and A-2 for the applicable control schematic and wiring harness. The control board is ac-

cessible for replacement through the front or top access openings.

Connector: A single connector (P1/J1) is used for all connections between the control board and harness. When separating the connector, use a small flat-bladed screwdriver to lever out the catch.

⚠CAUTION *Makeshift meter test probes used for testing Control Board connections during troubleshooting can damage pin sockets by spreading or dislodging the contact wiper arms, resulting in an open or intermittent electrical connection. Use a mating pin (PN 323–1605) or a test probe that is 0.045 inches in diameter. Replace damaged pin sockets (PN 323–1614–01). Make sure the pin sockets are fully seated and can't be pulled out.*

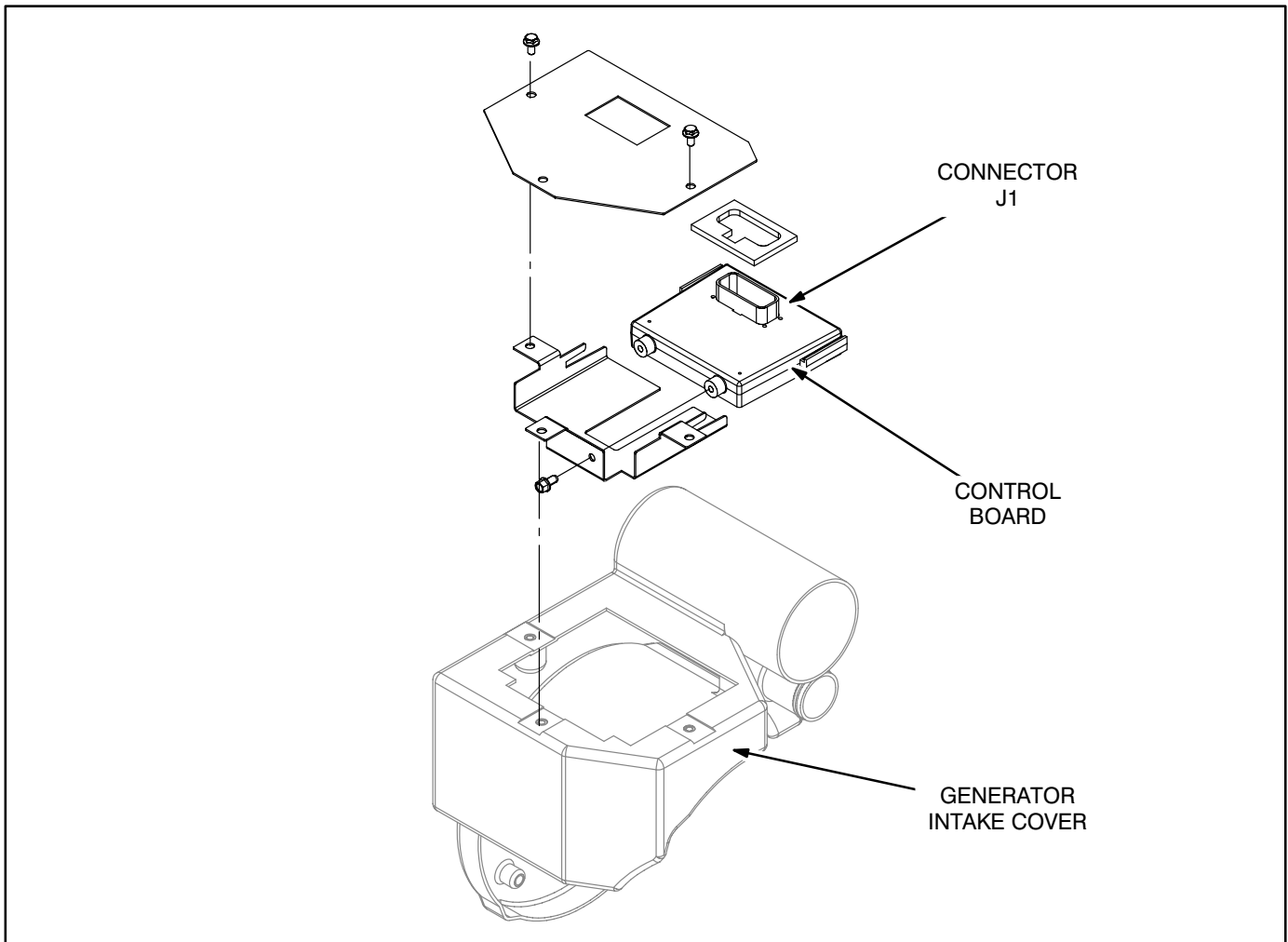


FIGURE. 11-1 CONTROL BOARD (BEGINNING SPEC C)

Control Board (Prior to Spec C)

Refer to Figure 11-2 for control board location and mounting and to Pages A-4 and A-5 for the applicable control schematic and wiring harness. The control board is mounted inside the engine air intake resonator with three screws.

Connectors: Two connectors, **P1/J1**, which is gray and mounted outboard of the other connector, and **P2/J2**, which is black and mounted inboard, are used for all connections between the control board and harness. When separating the connectors, use a small flat-bladed screwdriver to lever out the catch.

⚠ CAUTION *Makeshift meter test probes used for testing Control Board connections during troubleshooting can damage pin sockets by spreading or dislodging the contact wiper arms, resulting in an open or intermittent electrical connection. Use a mating pin (PN 323-1605) or a test probe that is 0.045 inches in diameter. Replace damaged pin sockets (PN 323-1614-01). Make sure the pin sockets are fully seated and can't be pulled out.*

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Removing the Control Board:

1. Remove the top and back housing panels and tilt out the end panel (p. 4-4).
2. Disconnect the two connectors from the control board. Use a small flat-bladed screwdriver to lever out the catch on the connectors.
3. Remove the two air tubes from the resonator assembly and the six nuts that secure the resonator to the housing panel and pull away the resonator.
4. Remove the three screws (two bottom, one top) that secure the control board to the resonator and withdraw the control board.

Installing the Control Board: Installation is the reverse of removal. Do not exceed the torque specification (p. 15-1) when tightening the resonator mounting nuts.

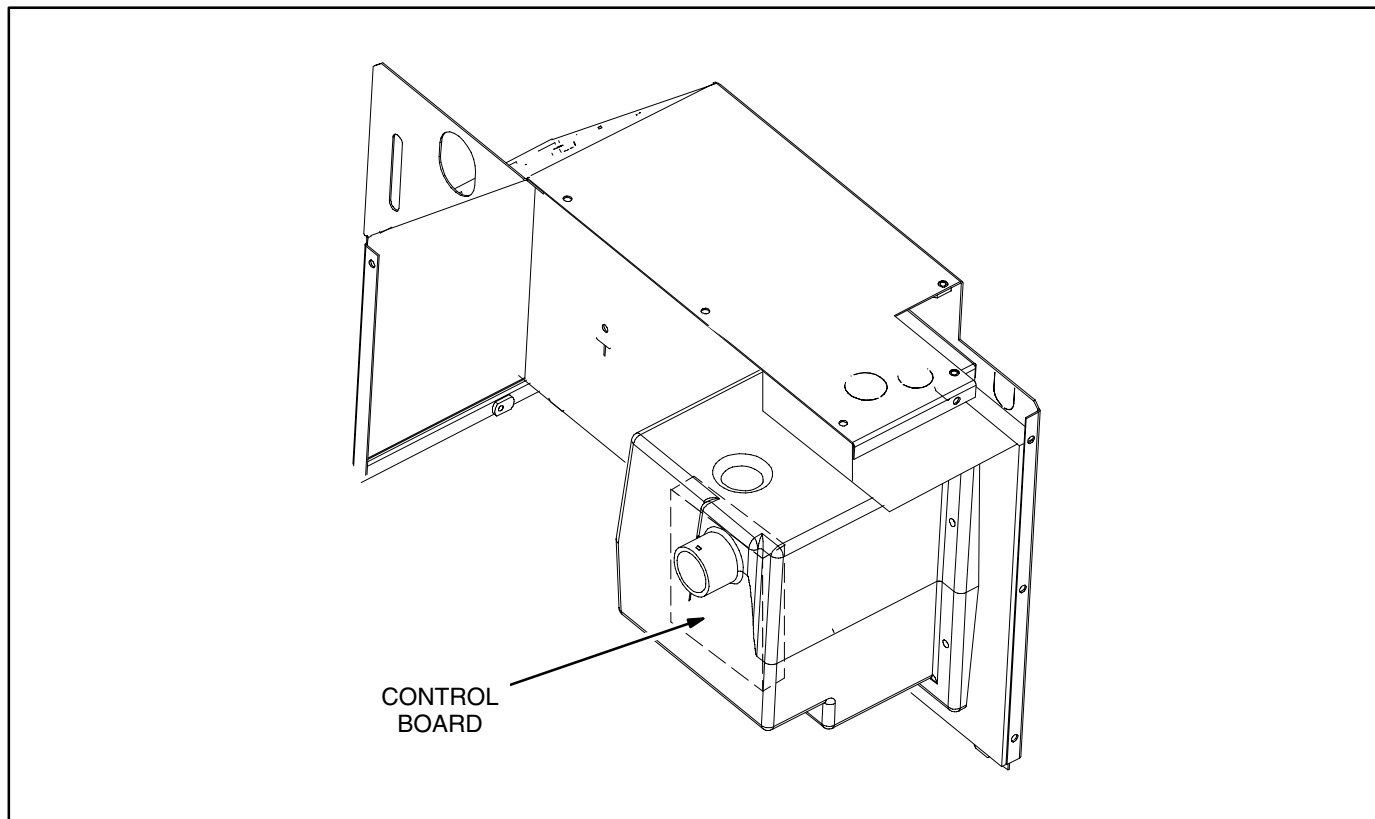


FIGURE 11-2. CONTROL BOARD (PRIOR TO SPEC C)

Major Controller Functions

Figure 11-3 is a block diagram of Controller functions.

Initialization: Control initialization consists of checking memory (RAM, ROM, EEPROM) and genset configuration.

Fuel Priming: Press and hold the control switch at **STOP (Prime)** for more than 3 seconds to cause fuel pump E2 to prime the fuel system.

Starting: Press and hold the control switch at **START (Preheat)** until the genset starts. The Controller:

1. Energizes fuel lift pump E2.
2. Energizes the glow plugs (3) during pre-heat and cranking. The duration of pre-heat prior to cranking is engine temperature dependent, but does not exceed 15 seconds.
3. Enables the status lamp to blink rapidly.
4. Enables some fault detection.
5. Enables cranking for up to 35 seconds.
6. Enables field flash (F1-F2).
7. Energizes governor actuator E1 (full rack).
8. Disconnects the starter at 800 rpm.
9. When operating speed is reached:
 - A. Enables output voltage.
 - B. Turns off field flash.
 - C. Turns on status lamp.
 - D. Enables Switched B+ (J1-8).

E. Enables complete fault detection.

Stopping: Touch the control switch to **STOP (Prime)**. The Controller:

1. Disables output voltage.
2. Deenergizes the fuel lift pump and governor actuator.
3. Turns off the status lamp.
4. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
5. Removes processor power when idle 5 minutes.

Note: Stop takes precedence over Start if both present due to a faulty switch or other cause.

Controlling Voltage: The Controller maintains nominal AC output voltage as load varies by varying field voltage. In response to transient loads, it lowers the voltage setpoint to allow engine recovery. Field power is supplied by the quadrature windings (Q1-Q2).

Beginning Spec C, voltage can be adjusted. See ADJUSTING VOLTAGE (p. 10-6).

Controlling Fuel: The Controller positions the fuel rack to maintain nominal frequency as load varies by sending a pulse-width-modulated square-wave signal (PWM) to governor actuator E1. It determines frequency by sensing the zero crossings of the quadrature winding output. When the actuator is not energized, its spring-loaded plunger holds the fuel rack in the no-fuel position.

Fault Monitoring, Shutdown and Diagnostics: See Section 12. Troubleshooting.

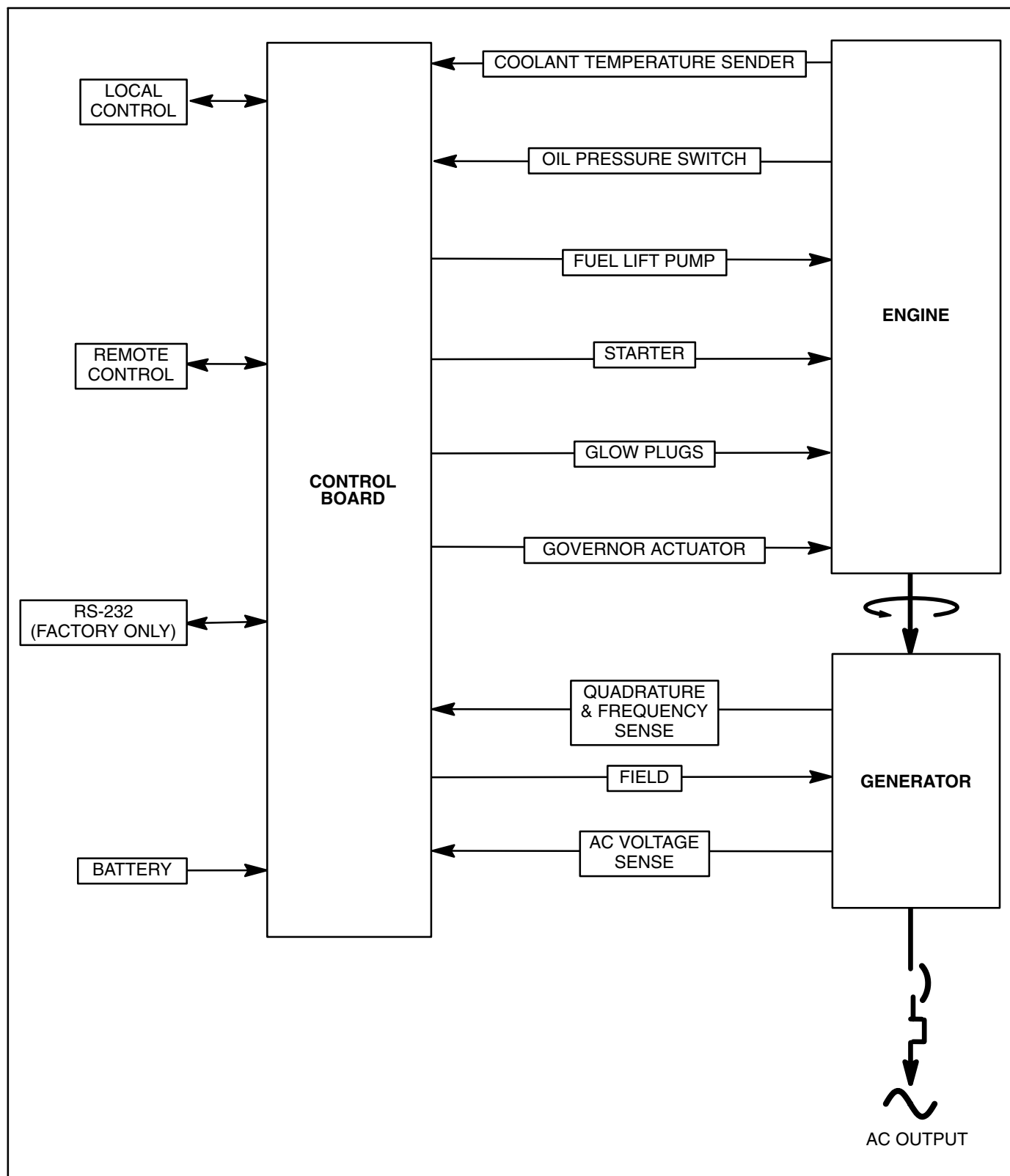


FIGURE 11-3. CONTROL BLOCK DIAGRAM

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

LOCAL AND REMOTE CONTROL SWITCHES

(Refer to Pages A-1 through A-5, as appropriate, while following the steps below.)

Control Switch Tests

Local Control Switch S1: Switch S1 is mounted on the control panel (Figure 11-4). Unsnap connector **P9**, which is accessible through the front access door. Referring to Figure 11-5, replace the switch if:

- The switch does not close across terminals **2** and **3** when held in the Start position
- The switch does not close across terminals **1** and **2** when held in the Stop position
- The status indicator light does light when 12 VDC is connected across terminals **7** (–) and **8** (+).

Remote Control Switch: Disconnect remote control connector **J8/P8** and test a remote control switch (customer supplied) in the same manner as switch S1 and repair as necessary.

Wiring Harness Tests

If the control switches are good but the Start / Stop circuit still does not work, test the wiring harness between the control switches and control board.

Beginning Spec C, disconnect **P1** from the control board (p. 11-1).

- **P1-9** should close to **P1-27** when the local or remote switch is held in its Start position.
- **P1-32** should close to **P1-27** when the local or remote switch is held in its Stop position.

Prior to Spec C, disconnect **P1** (gray, outboard) from the control board (p. 11-2).

- **P1-3** should close to **P1-5** when the local or remote switch is held in its Start position.
- **P1-4** should close to **P1-5** when the local or remote switch is held in its Stop position.

Replace broken or missing wires and bent or corroded terminals.

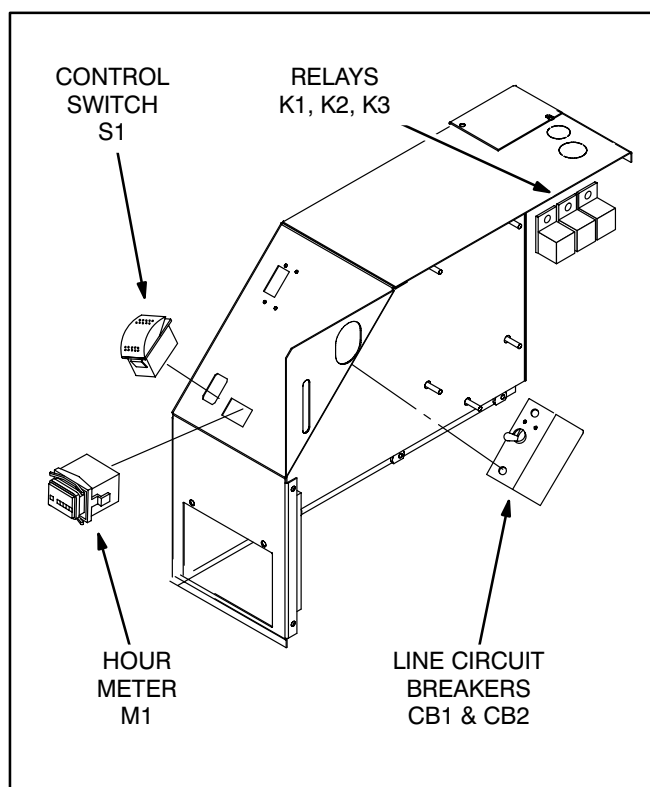


FIGURE 11-4. CONTROL COMPONENTS

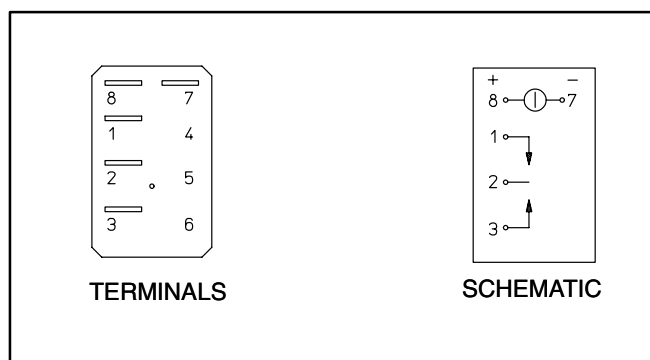


FIGURE 11-5. CONTROL SWITCH S1

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Before removing a housing panel or access door, disconnect the negative (–) cable at the battery to prevent the engine from starting.*

RELAYS K1, K2, K3

These relays (Figure 11-4) are secured in a row above the intake resonator and are accessible for replacement through the top access door. To test a relay, apply 12 VDC across terminals 85–86 (Figure 11-6). Replace the relay if 30–87a (NO) does not close or 30–87 (NC) does not open, or either does not return to its normal position when power is removed.

See Page A-1 for the function of each relay (3) on models beginning Spec C. See Page A-4 for the function of each relay (2) on models prior to Spec C.

CONTROL FUSES F1, F2

These fuse are provided only on models prior to Spec C. They are part of the wiring harness (p. A-5) and are accessible for replacement through the access plate on the control panel (p. 2-2).

HOUR METER

The hour meter (Figure 11-4) is mounted on the control panel and is accessible for replacement through the front access door. It cannot be reset.

LINE CIRCUIT BREAKERS CB1, CB2

The line circuit breakers (Figure 11-4) are mounted on the control panel and are accessible for replacement through the front door. Disconnect all wiring and check electrical resistance across the terminals of each circuit breaker. Replace a circuit breaker that does not reset or that does not close or open as the handle is turned ON and OFF.

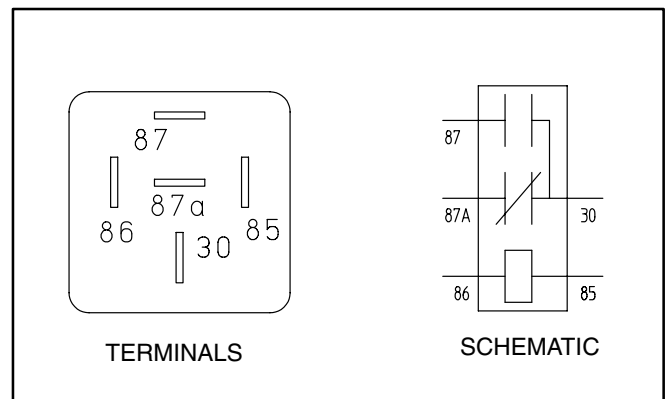


FIGURE 11-6. RELAYS K1, K2, K3

12. Troubleshooting

TROUBLESHOOTING WITH TABLE 12-1

To aid troubleshooting, the genset controller causes the status indicator light to blink the numeric code assigned to the fault that caused shutdown. For a brief description of the fault and step-by-step corrective action, refer to TABLE 12-1. TROUBLESHOOTING, which lists the fault codes in numerical order.¹

FAULT CODE BLINKING

At fault shutdown, the status indicator light will repeatedly blink sets of 1, 2, 3 or 4 blinks.

- **One blink** indicates shutdown due to high engine coolant temperature.
- **Two blinks** indicate shutdown due to a loss of engine oil pressure.
- **Three blinks** indicate a service fault. Press **Stop** once to cause the two-digit, second-level shutdown code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1, 2, 3, 4 or 5 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the shutdown code number. For example, **shutdown code No. 36** appears as:

blink-blink-blink—*pause*—blink-blink-blink-blink-blink-blink—
long pause—repeat

- **Four blinks** (beginning Spec C) indicate that cranking time exceeded 35 seconds.
- *To avoid the possibility of anyone misinterpreting Code Nos. 3 and 4 as Code Nos. 33 and 44, the latter have not been assigned faults.*

RESTORING FAULT CODE BLINKING

The fault code stops blinking after five minutes. Press **Stop** three times within three seconds to restore fault code blinking.

Note: The last fault logged will blink even though the condition that caused the shutdown may have been corrected.

BYPASSABLE FAULTS

On Models Prior to Spec C there are two faults that the genset controller automatically bypasses when a *second* attempt is made to restart the genset. They are:

- **No. 23** - Faulty Low Oil Pressure Cutout Switch
- **No. 24** - Faulty Engine Temperature Sender

⚠ CAUTION *Operating the genset with faulty engine sensors can lead to serious engine damage. Read the genset Warranty regarding possible exclusions when operating under such conditions.*

1. It should be noted that most shutdowns probably can be avoided in the first place by performing periodic maintenance on schedule (TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE) and by *not* running the genset out of fuel. In regard to running the genset out of fuel, note that when the genset and vehicle engine share a common fuel tank, the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

NO RESPONSE AT CONTROL SWITCH

Beginning Spec C

(Faulty switch, poor or missing connections, dead battery)

Corrective Action: *Refer to Pages A-1 through A-3.*

1. Try the genset (local) control switch if there is no response at the remote control switch, and vice versa.
 - If there is no response at either remote or local switch, go to Step 2.
 - If there is no response at the remote switch but at the local, go to Step 3.
 - If there is no response at the local switch but at the remote, go to Step 6.
2. Check for 12 VDC across genset battery cable terminal block **TB1**. *If there is no voltage*, service as necessary by cleaning and tightening battery cable connections, recharging or replacing the battery or replacing damaged or missing battery cables. *If there is voltage* across **TB1**, but no response at either remote or local switch, go first to Step 3, and then, if necessary, also to Step 6.
3. Disconnect harness connector **P8** from the remote circuits. Check for **B+** (12 VDC) at **P8-C** (Start) and at **P8-E** (Stop) and for ground continuity at **P8-A** (Ground). If there is **B+** and ground continuity, service the remote switch and harness (p. 11-5). If not, go to Step 4.
4. Disconnect harness connector **P1** from the control board (p. 11-1) and check for **B+** at **P1-10** and for ground continuity at **P1-27**. If there is **B+** and ground continuity, go to Step 5. If not, go to Step 9.
5. Check for wiring continuity in the harness between connectors **P8-C** and **P1-9** (Start), **P8-E** and **P1-32** (Stop), **P8-B** and **P1-7** (Status), **P8-F** and **P1-8** (Run) and **P8-A** and **P1-27** (Ground). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
6. Disconnect harness connector **P9** from control switch S1 (p. 11-5). Check for **B+** (12 VDC) at **P9-3** (Start) and at **P9-1** (Stop) and for ground continuity at **P9-2** (Ground). If there is **B+** and ground continuity, test control switch S1 and replace if necessary (p. 11-5). If not, go to Step 7.
7. Disconnect harness connector **P1** from the control board (p. 11-1) and check for **B+** at **P1-10** and for ground continuity at **P1-27**. If there is **B+** and ground continuity, go to Step 8. If not, go to Step 9.
8. Check for wiring continuity in the harness between connectors **P9-3** and **P1-9** (Start), **P9-1** and **P1-32** (Stop), **P9-8** and **P1-7** (Status), **P9-7** and **P1-27** (Status Ground) and **P9-2** and **P1-27** (Start/Stop Ground). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
9. Remove the top access cover or housing panel (p. 4-4) and check that both harness connectors labeled **B1-BAT** are secure on the starter solenoid terminal, that **GND** is secure on the chassis ground (p. A-3) and that there is wiring continuity in the harness between connectors **P1-10** and **B1-BAT** and between connectors **P1-27** and **GND**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
10. Remove the top housing panel (p. 4-4) and replace broken or missing cables between **TB1** and the engine. Tighten loose connections.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

NO RESPONSE AT CONTROL SWITCH

Prior to Spec C

(Faulty switch, poor or missing connections, dead battery)

Corrective Action: *Refer to Pages A-4 and A-5.*

1. Try the genset (local) control switch if there is no response at the remote control switch, and vice versa.
 - If there is no response at either remote or local switch, go to Step 2.
 - If there is no response at the remote switch but at the local, go to Step 4.
 - If there is no response at the local switch but at the remote, go to Step 7.
2. Check fuse **F1** (p. 2-2). If blown, check for correct polarity at genset battery cable terminal block **TB1**. Reconnect if necessary and replace the fuse, which protects the control board from reverse polarity.
3. Check for 12 VDC across genset battery cable terminal block **TB1**. **If there is no voltage**, service as necessary by cleaning and tightening battery cable connections, recharging or replacing the battery or replacing damaged or missing battery cables. **If there is voltage** across **TB1**, but no response at either remote or local switch, go first to Step 4, and then, if necessary, also to Step 7.
4. Disconnect harness connector **P8** from the remote circuits. Check for **B+** (12 VDC) at **P8-C** (Start) and at **P8-E** (Stop) and for ground continuity at **P8-A** (Ground). If there is **B+** and ground continuity, service the remote switch and harness (p. 11-5). If not, go to Step 5.
5. Disconnect harness connector **P2** (black) from the control board (p. 11-2) and check for **B+** at **P2-2** and for ground continuity at **P2-3**. If there is voltage and ground continuity, go to Step 6. If not, go to Step 10.
6. Disconnect harness connector **P1** (gray) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P8-C** and **P1-3** (Start), **P8-E** and **P1-4** (Stop), **P8-B** and **P1-12** (Status), **P8-F** and **P1-11** (Run), **P8-A** and **P1-5** (Ground) **P8-H** and **P1-10** (Temp) and **P8-G** and **P1-1** (Oil). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
7. Disconnect harness connector **P9** from control switch S1 (p. 11-5). Check for **B+** (12 VDC) at **P9-3** (Start) and at **P9-1** (Stop) and for ground continuity at **P9-2** (Ground). If there is **B+** and ground continuity, test control switch S1 and replace if necessary (p. 11-5). If not, go to Step 8.
8. Disconnect harness connector **P2** (black) from the control board (p. 11-2) and check for **B+** at **P2-2** and for ground continuity at **P2-3**. If there is voltage and ground continuity, go to Step 9. If not, go to Step 10.
9. Disconnect harness connector **P1** (gray) from the control board and check for wiring continuity in the harness between connectors **P9-3** and **P1-3** (Start), **P9-1** and **P1-4** (Stop), **P9-8** and **P1-12** (Status), **P9-7** and **P2-3** (Status Ground) and **P9-2** and **P1-5** (Start/Stop Ground). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
10. Remove the top access cover or housing panel (p. 4-4) and check that both harness connectors labeled **B1-BAT** are secure on the starter solenoid terminal, that **GND** is secure on the chassis ground (p. A-3) and that there is wiring continuity in the harness between connectors **P2-2** and **B1-BAT** and between connectors **P2-3** and **GND**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the genset still does not start.
11. Remove the top housing panel (p. 4-4) and replace broken or missing cables between **TB1** and the engine. Tighten loose connections.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

THE STATUS LIGHT BLINKS BUT THE ENGINE DOES NOT CRANK

*Prior to Spec C**

(Low cranking current, blown fuse, poor connections, faulty starter)

Corrective Action: *Refer to Pages A-4 and A-5.*

1. Have the vehicle propulsion engine running while trying to start the genset. Its charging alternator may be able to maintain a high enough battery terminal voltage to start the genset.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.
3. Replace fuse **F2** if blown.
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
5. Remove the top housing panel (p. 4-4) and check for wiring continuity in the harness between connectors **SW** (starter solenoid) and **K2-87** (starter pilot relay), between **K2-30** and fuse **F2** and between fuse **F2** and **B+ (BAT)** (starter solenoid). Repair as necessary.
6. Check for proper operation of starter pilot relay K2 and replace if necessary (p. 11-6).
7. Disconnect harness connector **P1** (gray) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **J1-6** and **K2-85** and for ground continuity at connector **K2-86**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
8. Service or replace the starter motor assembly (p. 9-3).
9. Replace the control board (p. 11-2).

* – Compare with Starting Fault—Code No. 32 (p. 12-12) for Models beginning Spec C.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

THE ENGINE CRANKS BUT DOES NOT START

*Prior to Spec C**

(Marginal fuel delivery or faulty glow plugs, governor or engine)

Corrective Action: *Refer to Pages A-4 and A-5.*

1. Check fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Prime the engine fuel system for one minute (p. 2-3). If the fuel pump does not operate, check for loose wiring harness connectors **E2-1** and **E2-2** and reconnect them to the pump. If they were found connected, disconnect them and power the pump directly with a 12 volt battery. Replace the fuel pump if it does not operate. If the pump operates, disconnect **P2** (black) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P2-11** and **E2-1** and for ground continuity at connector **E2-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fuel pump still does not operate.
3. Check the engine air filter and remove any blockage (p. 3-5).
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
5. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
6. Replace the fuel filter (p. 3-7).
7. Conduct a fuel flow test and service as necessary (p. 5-1).
8. If loose, reconnect wiring harness connector **HR-1** to the glow plug bus bar. If it was found connected, check for **B+** on the glow plug bus bar while cranking. *If there is B+*, remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and ground. Replace all three glow plugs if any glow plug is open (p. 9-3). *If there is no B+*, disconnect harness connector **P2** (black) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P2-1** and **HR-1**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if there still is no **B+** at the glow plug bus bar during cranking.
9. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4). (The engine cannot start if the actuator fails to pull in its spring-loaded plunger.)
10. Service the fuel injectors and injection pump (p. 9-1).
11. Service the internal engine governor mechanism (p. 9-1).
12. Service a worn engine (p. 9-1).

* – Compare with Over Crank—Code No. 4 (p. 12-8) for Models beginning Spec C.

THE STARTER ENGAGES AND DISENGAGES

(Low cranking voltage)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. Its charging alternator may be able to maintain a high enough battery terminal voltage to start the genset.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(Marginal battery, battery connections or charging system)

Corrective Action: *Refer to Pages A-1 through A-5, as appropriate.*

1. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.
2. The genset has a feature whereby genset battery charging alternator **G1** (p. 9-3) can be disabled, via relay **K1** (p. 11-6), by connecting **B+** to remote connector pin **P8-D**. If disabled, review the installation to determine whether the charging alternator should be disabled.
3. Service the battery charging system in the vehicle or on the propulsion engine if either is depended upon to recharge the genset starting battery.
4. Remove the top access cover or housing panel (p. 4-4) and check for wiring continuity in the harness between charging alternator **G1** and starter solenoid terminal **B+ (BAT)**. Repair as necessary.
5. Check for proper operation of relay **K1** and replace if necessary (p. 11-6).
6. Check for wiring continuity in the harness between connectors **G1-VR** and **K1-87a**. Repair as necessary.
7. *For models beginning Spec C*, disconnect harness connector **P1** from the control board (p. 11-1). *For models prior to Spec C*, disconnect harness connector **P2** (black) from the control board (p. 11-2). Check for wiring continuity in the harness between connectors **P1-24** and **K1-30** (beginning Spec C) or **P2-11** and **K1-30** (prior to Spec C). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
8. Replace battery charging alternator **G1** (p. 9-3).

NO AC POWER WHEN GENSET IS RUNNING

(A Circuit Breaker is OFF, tripped or malfunctioning or there are poor AC harness connections)

Corrective Action: *Refer to Pages A-1 through A-5, as appropriate.*

1. Reset or turn ON genset circuit breakers **CB1** and **CB2**.
2. Reset or turn ON any other circuit breaker in the AC power supply system.
3. Check voltage at genset AC output terminal block **TB2** when the genset is running. If there is approximately 120 VAC across **TB2-1** and **TB2-3** and across **TB2-2** and **TB2-3**, repair or reconnect the wiring between the genset and the main vehicle distribution panel. If there is no voltage, go to Step 4.
4. Check for proper **AC** harness connections and repair as necessary (p. A-3).
5. Test each circuit breaker and replace if necessary (p. 11-6).

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

ENGINE OVER TEMPERATURE—CODE NO. 1

(During normal operation engine coolant temperature exceeded 239° F [115° C] for 10 seconds)

Corrective Action:

1. Check engine coolant level, add coolant as necessary and repair any leaks.
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the genset and clean out dirt fouling the radiator passages.
3. Watch the remote temperature gauge (optional on models prior to Spec C) and run fewer appliances at the same time to keep down engine temperature. (Note that high altitude and high ambient temperature decrease engine cooling capacity.)
4. Look for a loose or broken fan belt and readjust or replace as necessary (p. 8-1).
5. Check for air leaks in the housing as a result of missing or loose housing panels and access covers, including the access covers for the fuses and AC terminals (p. 4-4).
6. Clean and flush the cooling system to remove coolant passage fouling (p. 3-8).
7. If loose, reconnect wiring harness connector **E3-1** to engine coolant temperature sender E3 (p. 9-3). (The Controller interprets a loose lead touching ground as high temperature.)
8. Replace the coolant thermostat, which might not be fully opening. See Engine Workshop Manual 981-0525.
9. Test temperature sender E3 and replace if necessary (p. 9-3).

LOW OIL PRESSURE—CODE NO. 2

(During normal operation engine oil pressure dropped to less than 14 psi for 3 seconds—switch closed)

Corrective Action:

1. Check engine oil level, add oil as necessary and repair any leaks.
2. Drain the excess oil if the level is above Full on the dipstick. If the level is too high the crankshaft can whip the oil into foam, which the pump can't pump.)
3. Test low oil pressure cutoff switch S2 and replace if necessary (p. 9-3).
4. Service the engine. See Engine Workshop Manual 981-0525.

SERVICE CHECK—CODE NO. 3

(A second-level fault occurred)

Corrective Action: Check the second-level fault code by momentarily pressing Stop. The second-level fault will be one of the following in this table.

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

OVER CRANK—CODE NO. 4

Beginning Spec C

(First-level fault code—Cranking time exceeded 35 seconds)

Corrective Action: *Refer to Pages A-1 and A-2.*

1. Check fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Prime the engine fuel system for one minute (p. 2-3). If the fuel pump does not operate, check for loose wiring harness connectors **E2-1** and **E2-2** and reconnect them to the pump. If they were found connected, disconnect them and power the pump directly with a 12 volt battery. Replace the fuel pump if it does not operate. If the pump operates, disconnect **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-24** and **E2-1** and for ground continuity at connector **E2-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fuel pump still does not operate.
3. Check the engine air filter and remove any blockage (p. 3-5).
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
5. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
6. Replace the fuel filter (p. 3-7).
7. Conduct a fuel flow test and service as necessary (p. 5-1).
8. If loose, reconnect wiring harness connector **HR-1** to the glow plug bus bar. If it was found connected, check for **B+** on the glow plug bus bar while cranking. *If there is B+*, remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and ground. Replace all three glow plugs if any glow plug is open (p. 9-3). *If there is no B+*, check for proper operation of glow plug relay K3 (p. 11-6). If the relay functions properly, check for wiring continuity in the harness between connectors **HR1** and **K3-87** and for ground continuity at **K3-86**. If good, disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-23** and **K3-85** and between **P1-10** and **K3-30**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if there still is no **B+** at the glow plug bus bar during cranking.
9. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4). (The engine cannot start if the actuator fails to pull in its spring-loaded plunger.)
10. Service the fuel injectors and injection pump (p. 9-1).
11. Service the internal engine governor mechanism (p. 9-1).
12. Service a worn engine (p. 9-1).

OVER VOLTAGE—CODE NO. 12

(After voltage regulation was enabled Output Voltage jumped to more than 150 VAC [125% of rated] for 75 milliseconds or to more than 138 VAC [115% of rated] for 3 seconds)

Corrective Action:

1. Push the line circuit breaker to OFF, start the genset and measure output voltage. If output voltage is normal, the problem is in the circuits external to the genset. If there is no voltage, test for grounded or shorted main, field or quadrature windings and service as necessary (p. 10-1).
2. Replace the control board (p. 11-1 or 11-2).

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

UNDER VOLTAGE—CODE NO. 13

(After voltage regulation was enabled Output Voltage fell to less than 108 VAC
[90% of rated] for 5 seconds)

Corrective Action:

1. Push the line circuit breaker to OFF, start the genset and measure output voltage. If output voltage is normal, the problem is in the circuits external to the genset. If there is no voltage, test for grounded or shorted main, field or quadrature windings and service as necessary (p. 10-1).
2. Replace the control board (p. 11-1 or 11-2).

OVER FREQUENCY—CODE NO. 14

(After the starter was engaged Frequency jumped to more than 70 Hz
for 40 milliseconds or to more than 66 Hz for 6 seconds)

Corrective Action:

1. Check for a tripped genset circuit breaker, reset it if necessary, and run with fewer connected loads. (A breaker tripping under load can cause genset frequency to overshoot.)
2. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime. (Air bubbles can disrupt frequency.)
3. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
4. Check high-idle speed and readjust if necessary (p. 9-4).
5. Replace the control board (p. 11-1 or 11-2).
6. Service the internal engine governor mechanism according to Engine Workshop Manual 981-0525.

UNDER FREQUENCY—CODE NO. 15

(During normal operation Frequency fell to less than 54 Hz for more than 8 seconds)

Corrective Action:

1. Push the line circuit breaker to OFF and restart the genset. If the genset now runs, run it with fewer connected loads, especially those with high motor starting loads such as air conditioners.
2. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime. (Air bubbles can disrupt frequency.)
3. Replace the engine air filter and clean the spark-arrest muffler (p. 3-5).
4. Replace the fuel filter (p. 3-7).
5. Conduct a fuel flow test and service as necessary (p. 5-1).
6. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
7. Check high-idle speed and readjust if necessary (p. 9-4).
8. Replace the control board (p. 11-1 or 11-2).
9. Service the fuel injectors and injection pump (p. 9-1).
10. Check fuel injection timing (p. 9-1).
11. Service the internal engine governor mechanism (p. 9-1).
12. Service a worn engine (p. 9-1).

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

ACTUATOR SHORTED OR OPEN—CODE NO. 19

Beginning Spec C

(At startup the Controller sensed an open or shorted governor actuator/harness)

Corrective Action: *Refer to Pages A-1 through A-3.*

1. If loose, reconnect wiring harness connectors **E1-1** and **E1-2** to the governor actuator. If they were found connected, disconnect the wiring harness and measure electrical resistance across the actuator leads. Replace the actuator if resistance is not 2.8 to 2.9 ohms.
2. **Beginning Spec C**, disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-28** and **E1-1** and for ground continuity at connector **E1-2**. **Prior to Spec C**, disconnect harness connector **P2** (black) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P2-10** and **E1-1** and for ground continuity at connector **E1-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fault still occurs.

STARTER SOLENOID SHORT—CODE NO. 21

Prior to Spec C

(At startup the Controller sensed an open or shorted starter solenoid/harness)

Corrective Action: *Refer to Pages A-4 and A-5.*

1. If loose, reconnect wiring harness connector **K2-85** to starter motor pilot relay K2 (p. 11-6).
2. Check for proper operation of starter motor pilot relay K2 (p. 11-6) and replace if necessary.

ACTUATOR OVERLOAD—CODE NO. 22

(Due to overload or low engine performance, the Controller maintained the governor actuator at full-duty cycle—maximum pulse-width-modulated square-wave signal [PWM]—for 60 consecutive seconds)

Corrective Action:

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
3. Replace the engine air filter and clean the spark-arrest muffler (p. 3-5).
4. Replace the fuel filter (p. 3-7).
5. Conduct a fuel flow test and service as necessary (p. 5-1).
6. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
7. Check high-idle speed and readjust if necessary (p. 9-4).
8. Service the fuel injectors and injection pump (p. 9-1).
9. Check fuel injection timing (p. 9-1).
10. Service the internal engine governor mechanism (p. 9-1).
11. Service a worn engine (p. 9-1).

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

FAULTY LOW OIL PRESSURE CUTOFF SWITCH—CODE NO. 23

Prior to Spec C

(While the genset was stopped, the Controller checked for and sensed an open oil pressure switch)

Corrective Action: See BYPASSABLE FAULTS (p. 12-1).

1. If loose, reconnect wiring harness connector **S2-1** to low oil pressure cutoff switch S2 (p. 9-3).
2. Test the pressure switch and replace if necessary (p. 9-3).
3. Disconnect harness connector **P1** (gray) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P1-2** and **S2-1**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fault still occurs.

FAULTY ENGINE TEMPERATURE SENDER—CODE NO. 24

(After 10 minutes of normal operation the Controller checked for and sensed an open temperature sender/harness)

Corrective Action: See BYPASSABLE FAULTS (p. 12-1).

1. If loose, reconnect wiring harness connector **E3-1** to engine coolant temperature sender E3 (p. 9-3).
2. Test the temperature sender and replace if necessary (p. 9-3).
3. **Beginning Spec C**, disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-21** and **E3-1**. **Prior to Spec C**, disconnect harness connector **P1** (gray) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P1-9** and **E3-1**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fault still occurs.

VAC SENSE LOST—CODE NO. 27

(The Controller lost VAC sensing during normal voltage regulation when the field was functioning normally and frequency was at least 40 Hz)

Corrective Action: Refer to Pages A-1 through A-5, as appropriate.

1. Disconnect Generator connector **J3/P3** and check for electrical continuity across pins **P3-1** and **P3-2**. Replace the generator stator assembly if the circuit is open.
2. **Beginning Spec C**, disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-34** and **J3-1** and between connectors **P1-33** and **J3-2**. **Prior to Spec C**, disconnect harness connector **P2** (black) from the control board (p. 11-2) and check for wiring continuity in the harness between connectors **P2-7** and **J3-1** and between connectors **P2-8** and **J3-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
3. Replace the control board (p. 11-1 or 11-2).

QUADRATURE SENSE FAULT—CODE NO. 28

Prior to Spec C

(The quadrature sense circuit on the Controller circuit board failed during normal operation)

Corrective Action: Replace the control board (p. 11-2).

TABLE 12-1. TROUBLESHOOTING

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

HIGH BATTERY VOLTAGE—CODE NO. 29

(During startup the Controller sensed that battery system voltage was greater than 19 volts for 1 second)

Corrective Action:

1. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2. Select a lower battery booster charge rate.

STARTING FAULT—CODE NO. 32

Beginning Spec C

(The Controller could not detect cranking speed [quadrature zero crossings] for 12 seconds)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. Its charging alternator may be able to maintain a high enough battery terminal voltage to start the genset.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.
3. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
4. Remove the top housing panel (p. 4-4) and check for wiring continuity in the harness between connectors **SW** (starter solenoid) and **K2-87** (starter pilot relay) and between **K2-30** and **B+ (BAT)** (starter solenoid). Repair as necessary.
5. Check for proper operation of starter pilot relay K2 and replace if necessary (p. 11-6).
6. Disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **J1-12** and **K2-85** and for ground continuity at connector **K2-86**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
7. Service or replace the starter motor assembly (p. 9-3).
8. Replace the control board (p. 11-1).

EE CHECKSUM FAULT—CODE NO. 35

(During startup EE checksum did not agree with stored EE checksum)

Corrective Action: Replace the control board (p. 11-1 or 11-2).

TABLE 12-1. TROUBLESHOOTING

⚠WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

MECHANICAL FAULT—CODE NO. 36

(The Controller declared this fault because engine speed fell below 1000 RPM for 0.5 seconds, though not by Controller action)

Corrective Action:

1. Check fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Prime the engine fuel system for one minute (p. 2-3).
3. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
4. Check the engine air filter and remove any blockage (p. 3-5).
5. Replace the fuel filter (p. 3-7).
6. Conduct a fuel flow test and service as necessary (p. 5-1).
7. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
8. Replace the control board (p. 11-1 or 11-2).
9. Service the engine (p. 9-1).

INVALID GENSET CONFIGURATION—CODE NO. 37

Prior to Spec C

(During startup a processor memory error occurred)

Corrective Action: Replace the control board (p. 11-2).

FIELD OVERLOAD—CODE NO. 38

(During normal voltage regulation Field Voltage exceeded 180 VAC for 10 seconds)

Corrective Action:

1. Reduce the number of air conditioners running at the same time, and other appliances that cause low power factor. (The lower the power factor of a motor or compressor, the more current it draws per kilowatt. The genset Controller, in turn, must boost field voltage to meet the higher demand for current imposed by low power factor.)
2. Have the air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause a very low power factor.)
3. Test the generator field and stator windings and service as necessary (p. 10-1).

GENERATOR ROTOR SHORT—CODE NO. 41

Beginning Spec C

(While flashing the field the Controller sensed that the rotor circuit was shorted to ground)

Corrective Action:

1. Disconnect Generator connector **J3/P3** and check for a short to ground at **P3-7** and at **P3-8** (p. 10-1). Service or replace brushes, slip rings and rotor as necessary.
2. Replace the control board (p. 11-1).

ROM FAULT—CODE NO. 42

Beginning Spec C

(During startup ROM checksum did not agree with stored ROM checksum)

Corrective Action: Replace the control board (p. 11-1).

TABLE 12-1. TROUBLESHOOTING

<p>⚠WARNING <i>Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.</i></p>
<p style="text-align: center;">RAM FAULT—CODE NO. 43 <i>Beginning Spec C</i> (During startup RAM Read & Write failed)</p> <p>Corrective Action: Replace the control board (p. 11-1).</p>
<p style="text-align: center;">SPEED SENSE LOST—CODE NO. 45 (After start disconnect the Controller lost speed sense [quadrature zero crossings] for 0.25 seconds)</p> <p>Corrective Action:</p> <ol style="list-style-type: none"> 1. Disconnect Generator connector J3/P3 and check for open and shorted field (P3-7—P3-8) and quadrature (P3-3—P3-6) windings (p. 10-1). Service or replace brush block, slip rings, rotor or stator as necessary. 2. Replace the control board (p. 11-1 or 11-2).
<p style="text-align: center;">LOSS OF FIELD SENSE—CODE NO. 48 <i>Beginning Spec C</i> (The field sense circuit on the Controller circuit board failed during normal voltage regulation)</p> <p>Corrective Action: Replace the control board (p. 11-1).</p>
<p style="text-align: center;">OVERPRIME—CODE NO. 57 <i>Beginning Spec C</i> (The local or remote control switch was held in the Prime position for more than 3 minutes)</p> <p>Corrective Action: Check for and remove any object that may be holding either control switch (remote or local) in the prime position.</p>

13. Service Checklist

After servicing, inspect and test the installation to confirm that the genset will operate as intended. Check each of the areas described below before putting the genset into service.

Housing

Check to see that all housing panels and access covers are in place and secure.

Mounting

Examine all mounting bolts and supporting members to verify that the genset is properly mounted. All fasteners should be tightened securely to prevent them from working loose when subjected to vibration.

Lubrication

If the engine oil was drained, refill as required.

Cooling System

If the engine coolant was drained, refill as required.

Wiring

Verify that all wiring connections are tight and installed properly. Check each of these connections:

- Load wires
- Control wires
- Ground straps
- Battery cables

Output Check

Apply a full load to make sure the genset can produce rated output. Use a load test panel to apply a progressively greater load until full load is reached.

Exhaust System

While the genset is running inspect the entire exhaust system. Look and listen for leaks at all con-

nections, welds, gaskets and joints. Also make sure the exhaust pipe is not overheating adjacent materials or equipment. Do not run the genset until all exhaust leaks have been repaired.

⚠️WARNING *Exhaust gas is deadly. The exhaust system must not leak and must discharge all exhaust away from the vehicle. Do not run the genset until the exhaust leaks have been repaired.*

The exhaust tailpipe must be supported by a hanger near the vehicle perimeter and terminate at least 1 inch outside the perimeter and at least 1 foot from doors and windows.

Fuel System

While the genset is running, inspect the fuel supply and return lines, filter and fittings for leaks. Check flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause leakage. Repair all fuel leaks immediately.

⚠️WARNING *Diesel fuel is combustible. Leaking fuel could lead to fire and to severe personal injury or death. Repair fuel leaks immediately.*

Control

Stop and start the genset several times at the control panel on the genset and at the remote control board (if provided) to verify that they work properly.

Mechanical

Stop the genset and inspect it for leaking gaskets, loose fasteners, damaged components and interference with other equipment. Repair as necessary. Inspect the generator compartment and verify that there are no breaks or openings in the vapor-proof wall that separates the compartment from the vehicle interior. Seal openings as necessary. Make sure that all soundproofing material is in place.

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14. Specifications

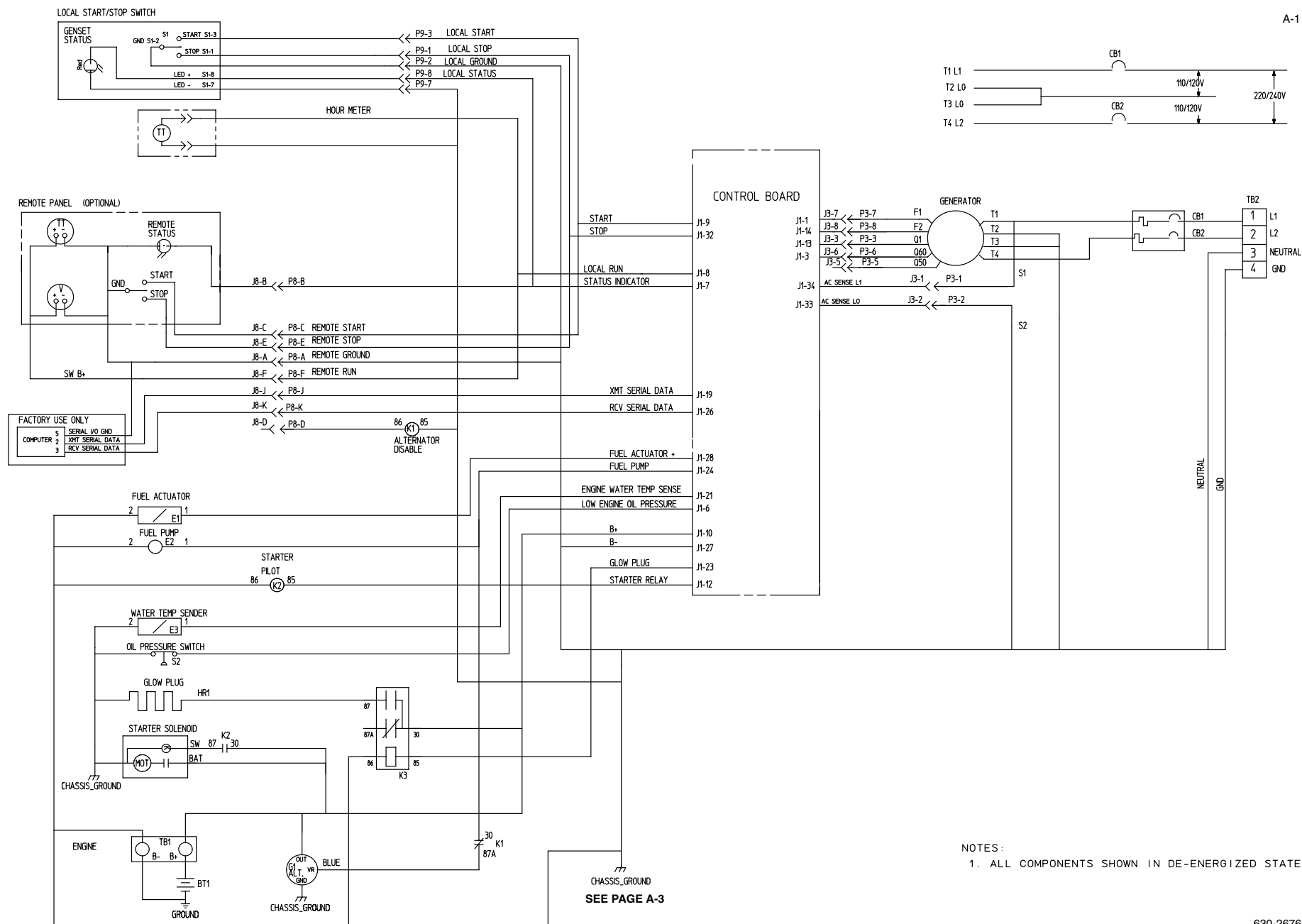
MODELS	HDCAA / HDCAC	HDCAB / HDCAD
GENSET CONTROL: Integrated Microprocessor-Based Engine and Generator Controller		
GENERATOR: Single-Bearing, 4-Pole Rotating Field, 1800 RPM		
Power (@ 1.0 power factor)	10,000 W	12,000 W
Voltage	120 / 240	120 / 240
Frequency	60 Hz	60 Hz
Number of Phases	1	1
Current	41.7 amps per leg	50 amps per leg
Line Circuit Breaker	2-pole, 45 amp	2-pole, 50 amp
FUEL CONSUMPTION:		
No-load	0.11 gph (0.41 lph)	0.11 gph (0.41 lph)
Half-load	0.62 gph (2.34 lph)	0.75 gph (2.84 lph)
Full-load	1.10 gph (4.16 lph)	1.33 gph (5.03 lph)
ENGINE: 3-Cylinder In-Line, Water-Cooled, Indirect-Injection, 4-Stroke Cycle Diesel		
Bore	3.27 in (83 mm)	
Stroke	3.62 in (92 mm)	
Displacement	91 in ³ (1,496 cc)	
Compression Ratio	22 : 1	
Fuel Injection Timing (BTDC)	19°	
Firing Order	1–3–2	
Cylinder Compression Test	370 psi (2.55 mPa) minimum @ 250 rpm	
Fuel Nozzle Injection Pressure	1900 psi (13.1 mPa)	
Valve Lash: Intake & Exhaust (cold)	0.008 in (0.20 mm)	
Oil Capacity (with filter)	6.7 quart (6.3 liter)	
Cooling System Capacity	6.1 quart (5.8 liter)	
DC SYSTEM:		
Nominal Battery Voltage	12 volts	
Minimum Battery Capacity CCA (Cold Cranking Amps)	475 amps down to 0° F (–17° C) 650 amps down to –20° F (–29° C)	
Max. Regulated Charging Current	20 amps	
Fuse F1 (prior to Spec C)	15 amp mini-bayonet	
Fuse F2 (prior to Spec C)	15 amp mini-bayonet	
WEIGHT: 660 lbs (300 kg)		
SIZE (L x W x H): 41.4 x 24.5 x 27 in (105 x 62 x 68.6 cm)		
SOUND LEVEL: 68 dB(A) @ 10 ft (3m) & 54 dB(A) @ 50 ft (15m)—in “free field site” @ half load		

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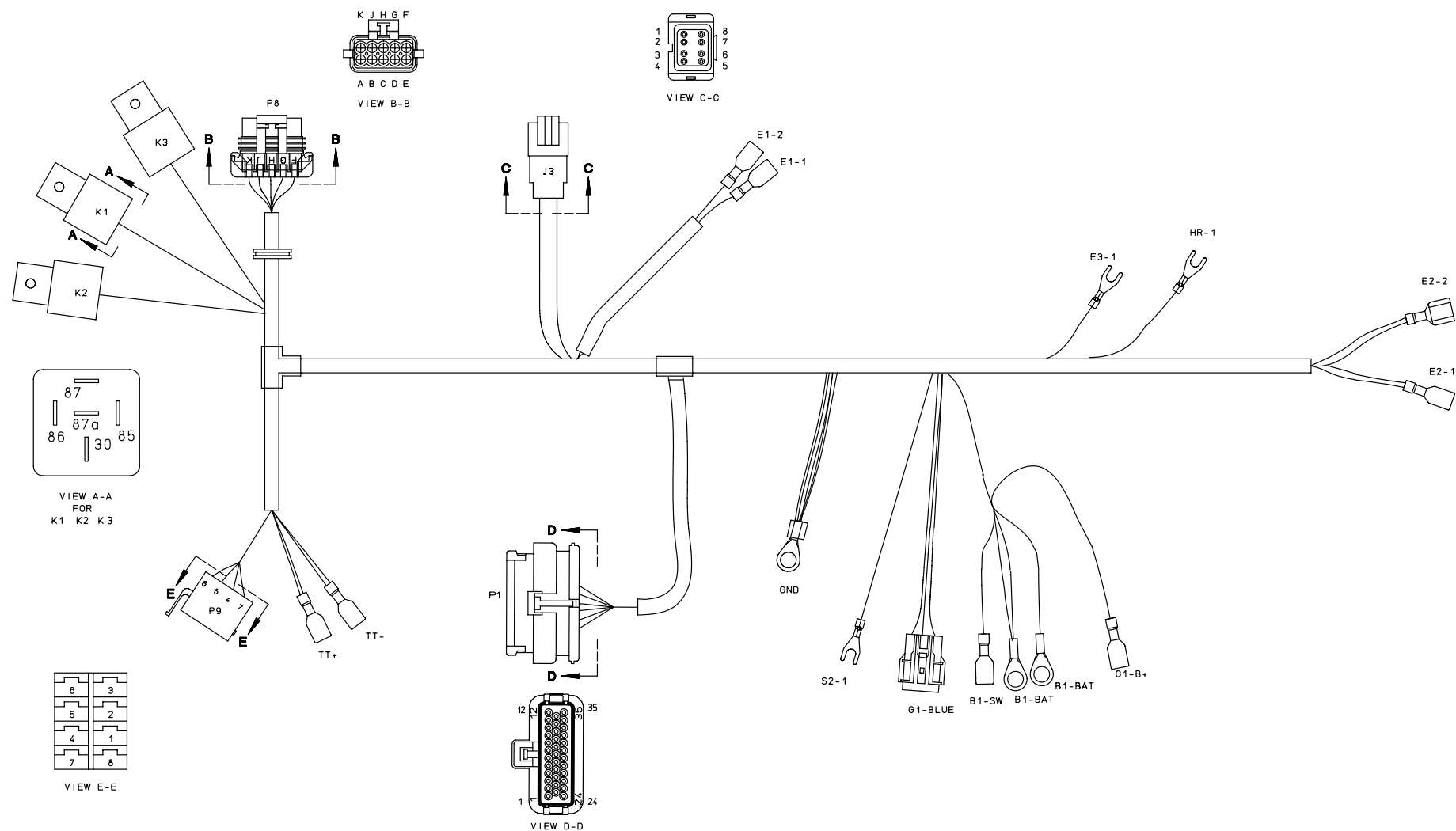
15. Thread Torques

	lb-ft*	N-m *
Housing Panel Screws	7-9	10-12
Intake Air Hose Clamp Screws	7-9	10-12
Intake Air Resonator Mounting Screws	6-12 lb-inch	0.7-1.4
Radiator Drain Plug	5	6-8
Radiator Access Plate Screws	7-9	10-12
Fuel Pump and Fuel Filter Bracket Mounting Screws	11-13	15-18
Fuel Fitting at Fuel Pump	7-9	10-12
Fuel Fittings at Fuel Filter—One flat passed finger tight.	—	—
Exhaust Assembly Flange Bolts	16-20	22-28
Battery Cable Terminal Block Terminal Nuts	6.7-8.3	9-11
Battery Cable Terminal Block Mounting Screws	7-9	10-12
Starter Solenoid Terminal Nuts	4.4-8.7	5.9-11.8
AC Output Terminal Block Terminal Screws	12-14 lb-inch	1.4-1.6
AC Output Terminal Block Mounting Screws	20-22 lb-inch	2.2-2.5
Circuit Breaker Terminal Screws	12-14 lb-inch	1.4-1.6
Circuit Breaker Mounting Screws	12-14 lb-inch	1.4-1.6
Generator Drive Disc to Flywheel Bolts	24-32	33-44
Generator Drive Disc to Rotor Bolts	19-21	25-29
Generator Through Bolt Nuts	20-25	28-34
Generator to Flywheel Housing Bolts	39	52
Flywheel Housing Mounting Bolts	30-40	41-55
Flywheel Mounting Bolts	65-80	88-108
Starter Mounting Bolts	18-22	24-30
Engine Mounting Brackets	18-22	24-30
Engine Lifting Bracket	18-22	24-30
Governor Actuator (Solenoid) Body	11-18	15-24
Coolant Temperature Sender (use thread sealant)	26-32	35-43
Low Oil Pressure Switch (use thread sealant)	10.8-14.5	14.7-19.6
Vibration Isolator Center Bolt	43-53	58-72
Vibration Isolator Mounting Screws	7-9	10-12
M6 Engine Bolts Except When Otherwise Specified	5.8-6.9	7.9-9.3
M8 Engine Bolts Except When Otherwise Specified	13.0-15.2	17.7-20.6
M10 Engine Bolts Except When Otherwise Specified	28.9-33.3	39.2-45.1
M12 Engine Bolts Except When Otherwise Specified	46.3-53.5	62.8-72.6
* – Use engine oil as a lubricant for all threads except when otherwise specified.		

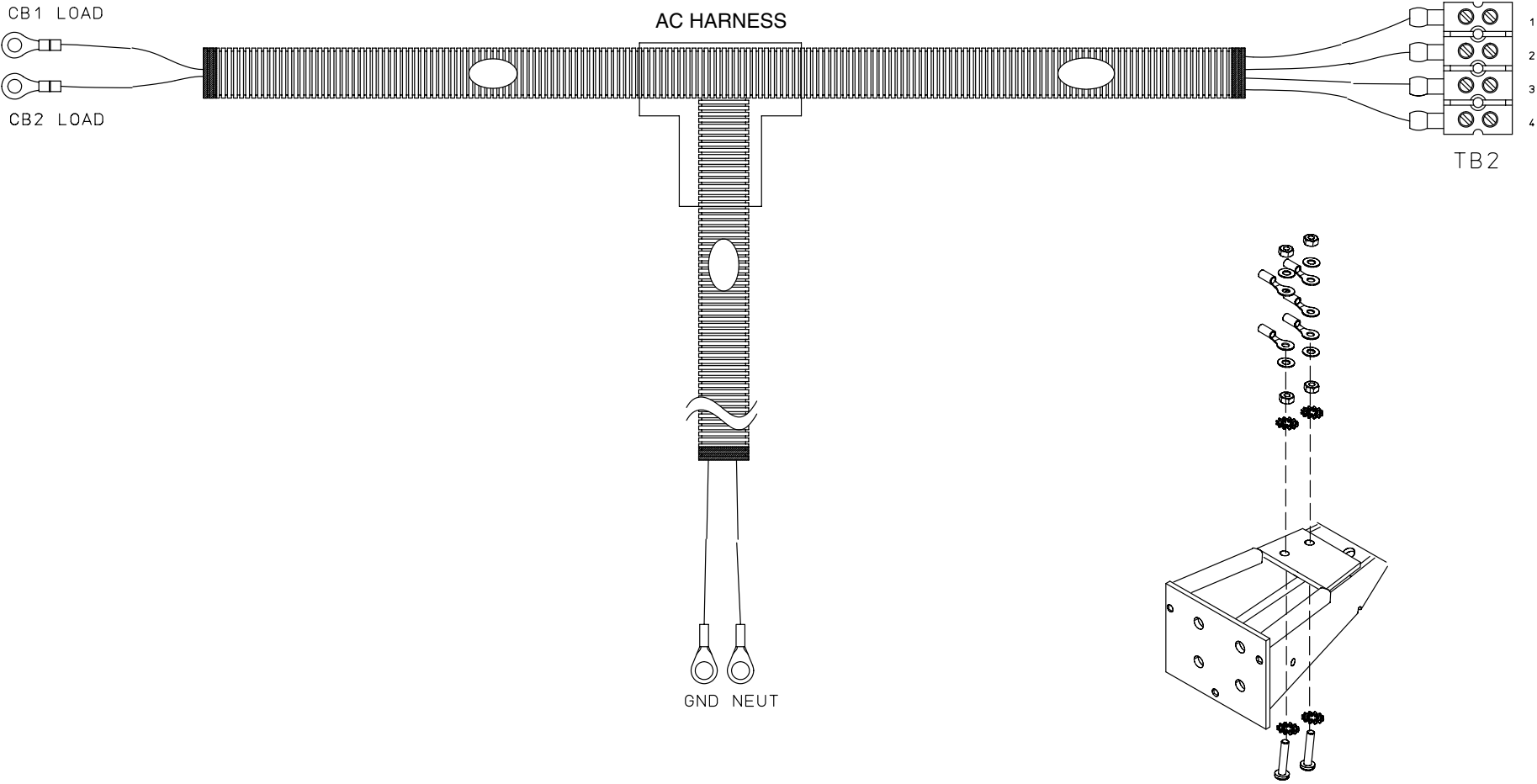
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WIRING SCHEMATIC (BEGINNING SPEC C)

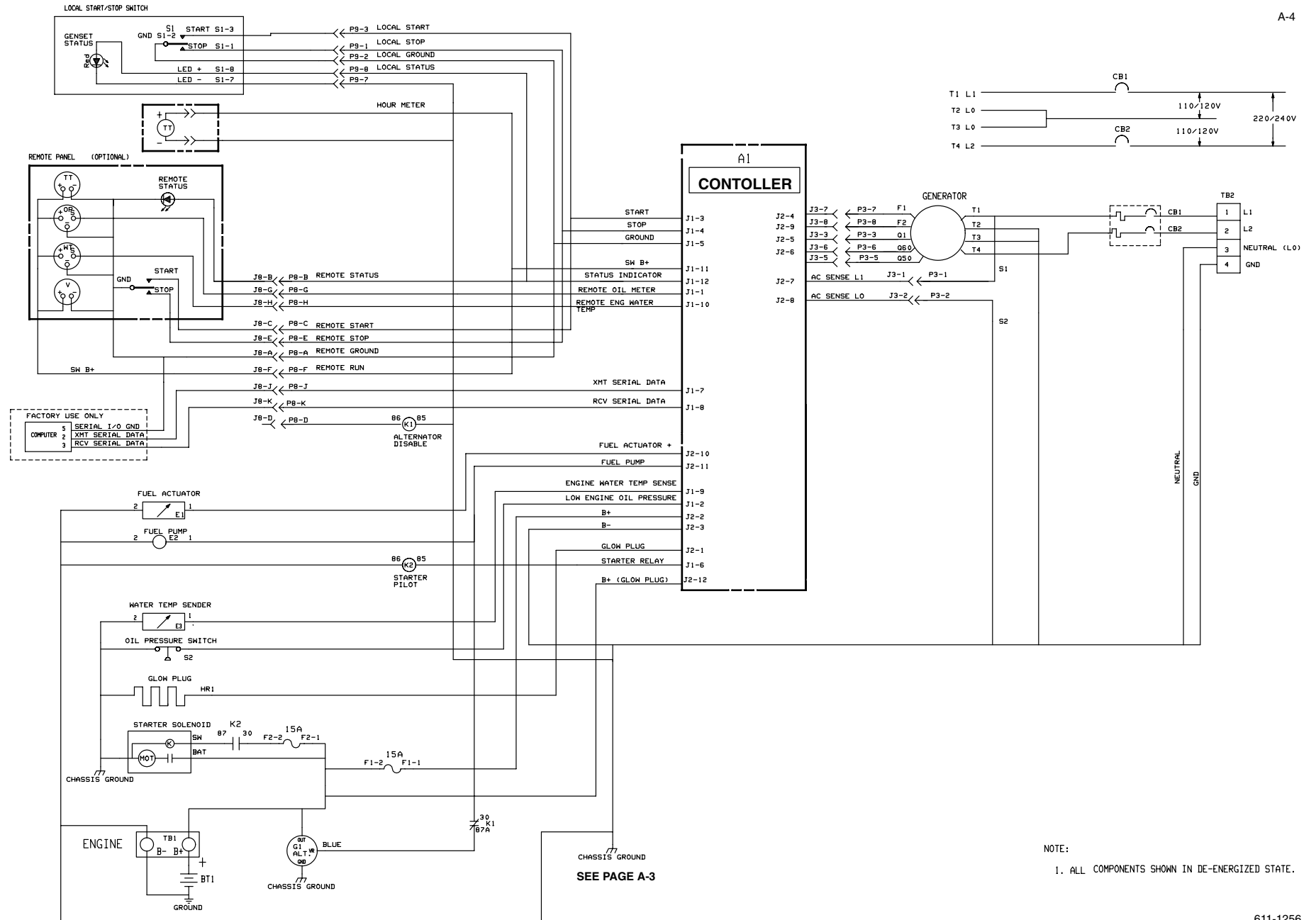


CONTROL WIRING HARNESS (BEGINNING SPEC C)



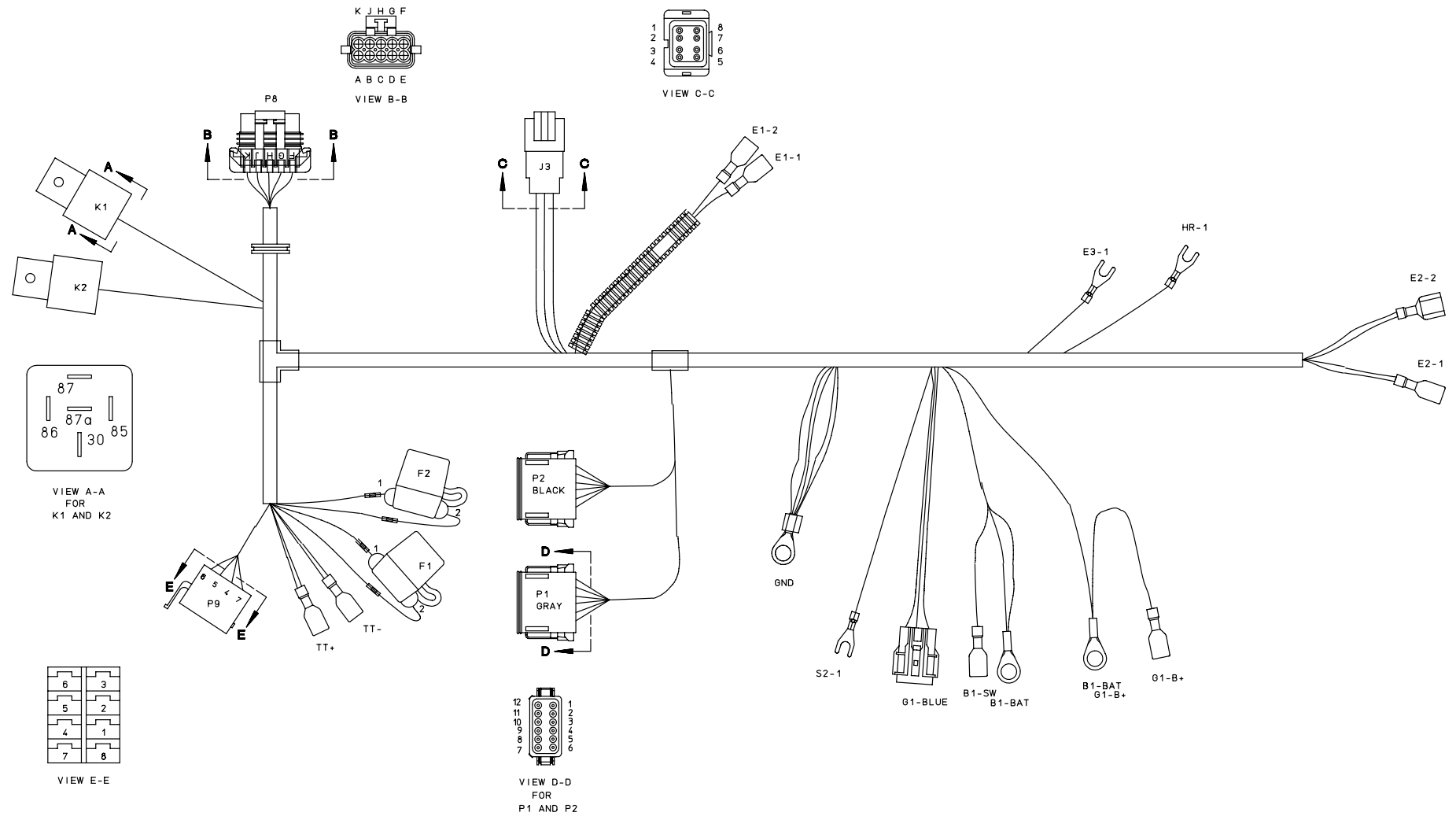
CHASSIS GROUNDS ON REAR ENGINE
MOUNTING BRACKET FOR AC HARNESS,
CONTROL HARNESS & GENERATOR T2, T3

AC WIRING HARNESS AND CHASSIS GROUNDS



WIRING SCHEMATIC (PRIOR TO SPEC C)

A-5



CONTROL WIRING HARNESS (PRIOR TO SPEC C)



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